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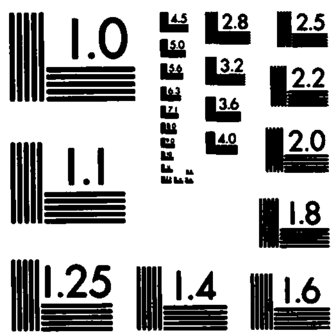

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AD-A134 028

CR 83.038

NAVAL CIVIL ENGINEERING LABORATORY
Port Hueneme, California

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NAVY ENERGY & NATURAL RESOURCES
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DAYLIGHTING COEFFICIENT OF UTILIZATION TABLES

August 1983

An Investigation Conducted by
APPLIED SOFTWARE ANALYSIS
2741 Iris Ave., Suite A
Boulder, Colorado 80302

N62583-83-MR-513

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METRIC CONVERSION FACTORS

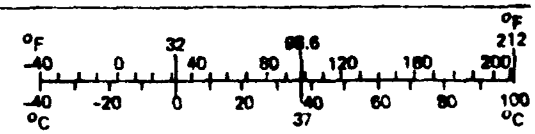
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1,000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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Lighting, illumination, daylighting, coefficient of utilization, computer program, window

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Use of daylighting coefficient of utilization tables provides a simple methodology for predicting interior illumination from daylight through windows. Tables are provided for transparent windows, and for windows with vertical and horizontal venetian blinds. The method predicts illuminance at five predefined target points within the room. The source code for

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TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

1. Summary

The purpose of this research was to develop and describe a methodology through which the effects of daylight in an interior environment may be quickly and accurately predicted.

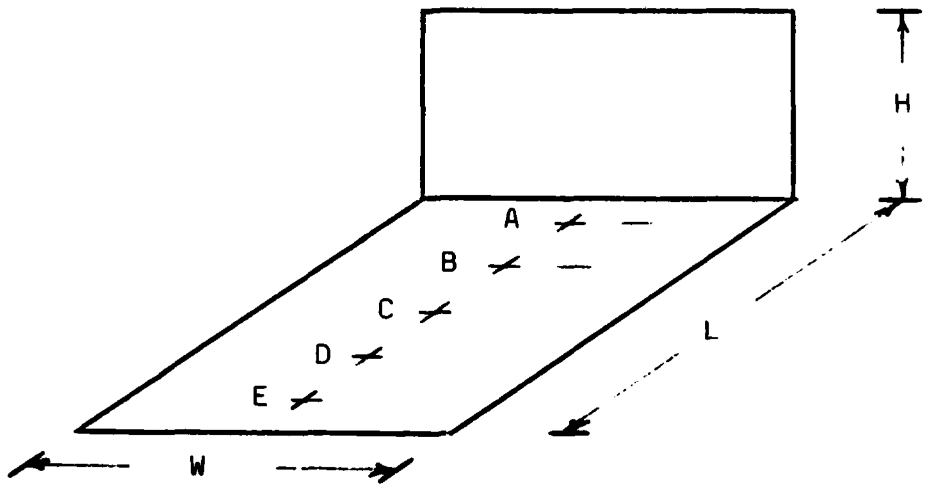
The research resulted in the computer program DAYCU2, which is implemented in FORTRAN-77 on the DEC VAX 11/780 minicomputer. The program will run without modification on any other model in the VAX series, and should be transportable with minimum conversion effort onto any other computer system which supports ANSI standard FORTRAN-77 and has sufficient memory (approx. 150k bytes).

Executing DAYCU2 generates the daylighting coefficient of utilization (CU) tables, which appear in Appendix T of this document. To use the tables, the user need only determine the vertical illuminance at the window produced by the sky and by the ground. If venetian blinds are involved the user must also determine the vertical illuminance produced by the sun. Once these illuminances are determined, a few multiplications and additions yield the predicted illuminance at any of 5 target points within the room.

The remaining sections of this document discuss:
1. The underlying assumptions involved in the generation of the CU tables.
2. How to use the CU tables.
3. Comparisons of results obtained with the CU tables against those obtained from the method given in the IES publication RP-5.
4. The mathematical basis and logic flow of the computer program DAYCU2.
5. Advice for getting the most out of the tables.

The CU tables themselves are given in Appendix T. Other appendices contain the DAYCU2 computer program source code and additional mathematical formulae and derivations not appropriately included elsewhere.

2. Characteristics of the Daylighting Environment



The following sub-sections describe the parameters and assumptions used in building the CU tables:

2.1 Room Characteristics

One wall of the room is completely occupied by the window. The transmittance of the window is 1; from Bryan[1], the transmission loss due to angle of incidence is assumed to obey

$$\text{Loss} = 1.018 \cos \psi \,(1 + \sin^3 \psi)$$

where ψ is the angular displacement between the incident ray and a normal to the window. Wall reflectances (except the window-wall) are all 50%; floor reflectance is 30%; ceiling reflectance is 70%. CU tables are generated for all combinations of the following ratios of room depth and room width to window height:

Room width / window height = ½, 1, 2, 3, 4, 6, 8, infinity

Room depth / window height = 1, 2, 3, 4, 6, 8, 10

2.2 Target Points

Target points A, B, C, D, and E are located along the floor at distances of 10%, 30%, 50%, 70%, and 90% of the room depth from the window. This is illustrated in the sketch above. The target points are located on the longitudinal centerline of the room -- i.e., each point is equidistant from the two walls which are adjacent to the window-wall.

[1] Harvey Bryan and Robert Clear, "Calculating Interior Daylight Illumination with a Programmable Hand Calculator", JIES, July 1981, pp. 219-227.

2.3 Sky

CU tables are generated for five different sky brightness distributions, according to the ratio of vertical-to-horizontal illuminance produced by a particular distribution. The five V:H ratios and the corresponding distributions are:

Vertical/Horizontal Illuminance	Sky Luminance Distribution
0.75	$L = L_z \left(.301 + 1.273 \exp(-.6/\sin h)\right)$
1.00	$L = L_z$
1.25	$L = L_z \left[\dfrac{1 - \exp(-.6/\sin h)}{1 - \exp(-.6)}\right]$
1.50	$L = L_z \left[\dfrac{1 - \exp(-.26/\sin h)}{1 - \exp(-.26)}\right]$
1.75	$L = L_z \left[\dfrac{1 - \exp(-.13/\sin h)}{1 - \exp(-.13)}\right]$

where

L_z = zenith luminance

h = altitude above horizon of point in sky

Note that in each case the sky brightness (luminance) depends only upon the zenith luminance and the solar altitude -- the brightness is independent of solar azimuth angle.

2.4 Ground

The ground is assumed to be an infinite flat Lambertian surface of constant exitance. Although the ground is thought of as a plane and the sky is thought of as a hemisphere, for calculation purposes the ground and the uniform sky may be treated exactly alike.

2.5 Sun

The CU tables take into account the effect of the sun on venetian blinds surfaces. In all other cases the presence of direct sunlight is ignored. If there are no venetian blinds, it is assumed that no sunlight enters the room directly, regardless of the solar position. Likewise, if blinds are present, but the blinds opening angle and solar profile angle are such that sunlight can penetrate the blinds, this direct sunlight is ignored.

The solar profile angle is the elevation above the horizontal of the projection of a vector from the window to the sun onto the vertical plane which is normal to the window. CU values are generated

for the following 6 profile angles:

0^0 (sun is on the horizon)
15^0
30^0
45^0
60^0
75^0

At 90^0 profile angle, the sun would be directly overhead. For vertical blinds the angles above should be interpreted as azimuth angles, where 0^0 azimuth means that the projection of the vector from the window to the sun upon a horizontal plane is normal to the window, etc. Note that if the profile or azimuth angle is 90^0 no sunlight can fall upon the window.

2.6 Venetian Blinds

Venetian blinds can be either horizontal slats or vertical slats type. Tables are generated for each of the 5 following values of blinds reflectance:

10 %
30 %
50 %
70 %
90 %

Blinds slats are assumed to be perfectly flat Lambertian surfaces. Slat width is taken to be 1.15 times spacing between slats; slat width is presumed small when compared with room dimensions. The following 6 blinds opening angles are covered in the tables:

0^0 (fully open)
15^0
30^0
45^0
60^0
75^0

A blinds opening angle = 90^0 would mean fully closed blinds.

3. How to Use the CU Tables

The tables are computed to three decimal places and printed with an implied decimal point. I.e., a table entry 076 means a coefficient = .076 There are four different kinds of tables:

i) Illuminance CU Tables (T-1 thru T-54)

These constitute the great bulk of the package and are used in all cases, blinds or no blinds. The tables are indexed as follows:

D / H - Room depth / window height

W / H - Window width / window height

% D - Location of target point in room -- 10% means 10% of the way from the window to the back wall.

ii) Solar Blinds Multipliers (T-55 thru T-56)

These tables are indexed by solar profile angle and blinds reflectance. There are 12 such tables, one each for each combination of six blinds angles and two blinds surfaces (top or underside). The solar blinds multipliers may be thought of as yielding the final exitance on the blinds, given the vertical solar illuminance, profile angle, and blinds reflectance.

iii) Sky Blinds Multipliers (T-57)

These are indexed by blinds angle and blinds reflectance. There is one table for the underside of blinds, and one table for the topside of blinds. The sky blinds multipliers may be thought of as yielding the final exitance on blinds, given the vertical illuminance due to the sky, blinds angle, and reflectance.

iv) Ground Blinds Multipliers (T-58)

These are indexed by blinds angle and blinds reflectance. There is one table for the underside of blinds, and one table for the topside of blinds. These multipliers may be thought of as yielding the final exitance on blinds, given the vertical illuminance due to the sky, blinds angle, and reflectance.

3.1 No Blinds

If no blinds are present on the window, we proceed by computing these two quantities:

$$E_{sky} = \tau \times V_{sky} \times T_{sky}$$

$$E_{grd} = \tau \times V_{grd} \times T_{grd}$$

where E_{sky} = desired illuminance at a target point in the room due to the sky

E_{grd} = desired illuminance at the target point due to the ground

τ = transmittance of the window glazing

V_{sky} = vertical illuminance at the window due to the sky

V_{grd} = vertical illuminance at the window due to the ground

T_{sky} = table entry for the sky luminance distribution, room dimensions, and target point in question. The tables are those on pages T-1 thru T-5.

T_{grd} = table entry for ground contribution. This is table on T-6.

EXAMPLE

Given: 40'L x 20'W x 10'H room reflectances 70/50/30

One 10' high x 8' wide window is centered on the south wall. Transmittance of glazing = 82%.

Sky is overcast.

Solar elevation angle = 45^{0}.

Ground reflectance = 15%.

Find: Illuminance on the floor midway in the room.

1. From Figure 3a we have V_{sky} = 625 fc and H_{sky} = horizontal illuminance due to the sky = 1580 fc
2. V_{grd} = .5 x .15 x 1580 = 118.5 fc
3. From table T-1 we have E_{sky} = .82 x 625 x .078 = 40 fc
4. From table T-6 we have E_{grd} = .82 x 118.5 x .078 = 8 fc

   (It is coincidence that the coefficient is .078 in each case -- we are rounding each final result to the nearest footcandle)
5. Adding the sky and ground contribution together, we get

   E_{total} = 48 fc
6. The tables presume that the window occupies the entire wall; therefore we must adjust by a factor equal to the proportion of the wall which is occupied by window, or:

$$E_{adjusted} = 48 \times \frac{(8)(10)}{(20)(10)} = 19 \text{ fc}$$

3.2 Blinds are Present

When venetian blinds are present we must compute the following intermediate quantities:

$$E_{sky-thru} = \tau \times V_{sky} \times T_{sky-thru}$$

$$E_{grd-thru} = \tau \times V_{grd} \times T_{grd-thru}$$

$$E_{sky-und} = \tau \times V_{sky} \times M_{sky-und} \times T_{und}$$

$$E_{grd-und} = \tau \times V_{grd} \times M_{grd-und} \times T_{und}$$

$$E_{sky-top} = \tau \times V_{sky} \times M_{sky-top} \times T_{top}$$

$$E_{grd-top} = \tau \times V_{grd} \times M_{grd-top} \times T_{top}$$

$$E_{sun-und} = \tau \times V_{sun} \times M_{sun-und} \times T_{und}$$

$$E_{sun-top} = \tau \times V_{sun} \times M_{sun-top} \times T_{top}$$

where $E_{sky-thru}$ = illuminance due to sky light which passes thru the blinds

$E_{grd-thru}$ = illuminance due to ground light which passes thru the blinds

$E_{sky-und}$ = illuminance due to that portion of underside blinds exitance which is due to the sky

$E_{grd-und}$ = illuminance due to that portion of underside blinds exitance which is due to the ground

$E_{sky-top}$ = illuminance due to that portion of topside blinds exitance which is due to the sky

$E_{grd-top}$ = illuminance due to that portion of topside blinds exitance which is due to the ground

$E_{sun-und}$ = illuminance due to that portion of underside blinds exitance which is due to the sun

$E_{sun-top}$ = illuminance due to that portion of topside blinds exitance which is due to the sun

V_{sun} = vertical illuminance at the window due to the sun

$M_{sky-und}$ = sky blinds multiplier for blinds underside (T-57)

$M_{grd-und}$ = ground blinds multiplier for blinds underside (T-58)

$M_{sky-top}$ = sky blinds multiplier for blinds topside (T-57)

$M_{grd-top}$ = ground blinds multiplier for blinds topside (T-58)

$M_{sun-und}$ = solar blinds multiplier for blinds underside (T-55,T-56)

$M_{sun-top}$ = solar blinds multiplier for blinds topside (T-55,T-56)

T_{und} = CU table entry for blinds underside (T-31 thru T-42)

T_{top} = CU table entry for blinds topside (T-43 thru T-54)

$T_{sky-thru}$ = CU table entry for sky-thru component (T-7 thru T-18)

$T_{grd-thru}$ = CU table entry for ground-thru component (T-19 thru T-30)

EXAMPLE

Given: 40'L x 20'W x 10'H room, reflectances 70/50/30

One 10' high x 8' wide window is centered on the south wall (south wall is 20' wide). Transmittance is .82

The window is completely covered by venetian blinds. The blinds are set at 30^{o}; reflectance of blinds = 50%

It is a clear summer day; solar elevation = 45^{o}. The sun directly faces the window-wall, so that solar azimuth angle = 0^{o} (therefore profile angle = 45^{o})

Ground reflectance = 15%.

Find: Illuminance at the floor midway in the room.

1. From Figure 3b (0^{o} azimuth curve) we have V_{sky} = 1480

2. From Figure 3e (0^{o} azimuth curve) we have V_{sun} = 5500

3. From Figure 3b, horizontal illuminance on the ground due to the clear summer sky is 1440 fc; from Figure 3e the horizontal illuminance on the ground from direct sunlight is 5500 fc. These total 6940 fc, so the vertical illuminance at the window due to the ground is:

$$V_{grd} = (.5)(.15)(6940) = 520$$

4. From the tables we find these CU values:

$T_{sky-thru}$ = .014	$T_{grd-thru}$ = .041
$M_{sky-und}$ = .084	$M_{grd-und}$ = .065
$M_{sky-top}$ = .407	$M_{grd-top}$ = .047
$M_{sun-und}$ = .075	$M_{sun-top}$ = .438
T_{und} = .054	T_{top} = .009

5. Combining, we get:

$E_{sky\text{-}thru}$	=	.82	x	1480	x	.014			=	17
$E_{grd\text{-}thru}$	=	.82	x	520	x	.041			=	17
$E_{sky\text{-}und}$	=	.82	x	1480	x	.084	x	.054	=	6
$E_{grd\text{-}und}$	=	.82	x	520	x	.065	x	..054	=	1
$E_{sky\text{-}top}$	=	.82	x	1480	x	.407	x	.009	=	4
$E_{grd\text{-}top}$	=	.82	x	520	x	.047	x	.009	=	0
$E_{sun\text{-}und}$	=	.82	x	5500	x	.075	x	.054	=	18
$E_{sun\text{-}top}$	=	.82	x	5500	x	.438	x	.009	=	18
										81

6. Finally, we must adjust by the proportion of wall which the 8' wide window occupies, or

$$E = (8/20) \times 81 = 32 \text{ fc}$$

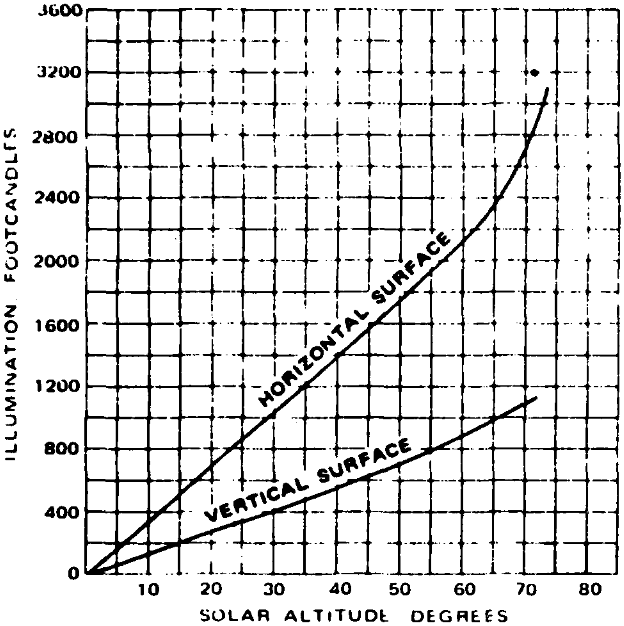


Figure 3a: Illuminance from an overcast sky (no sun)

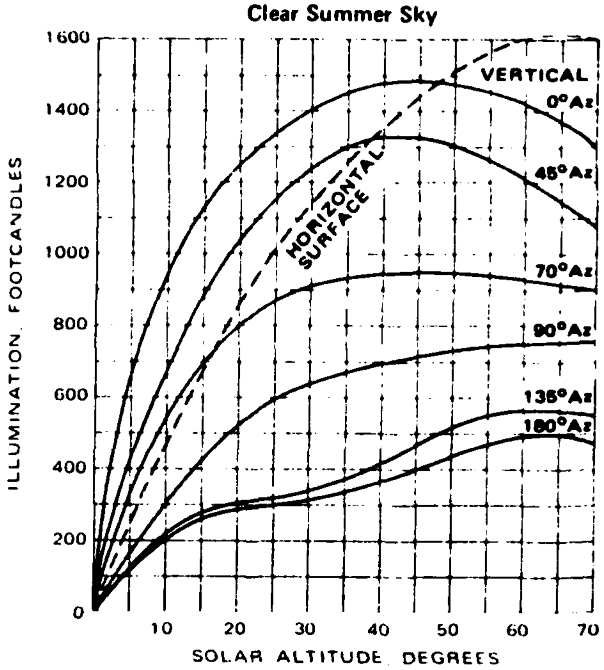


Figure 3b: Illuminance from a clear summer sky (no sun).

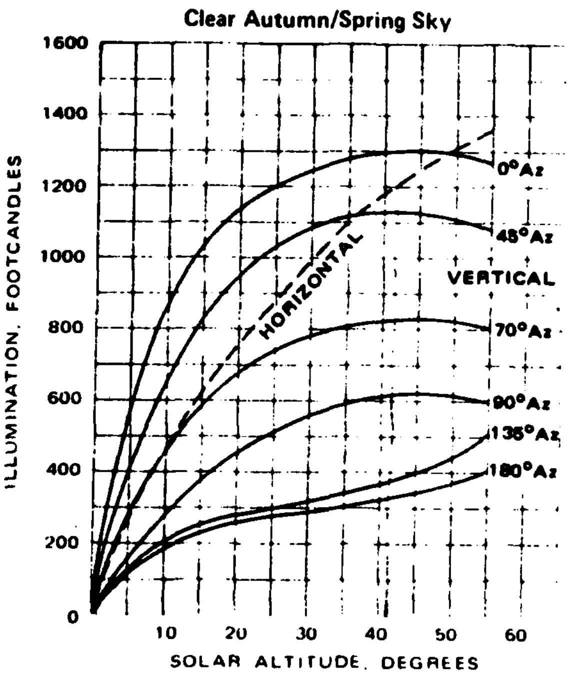


Figure 3c: Illuminance from a clear autumn/spring sky (no sun)

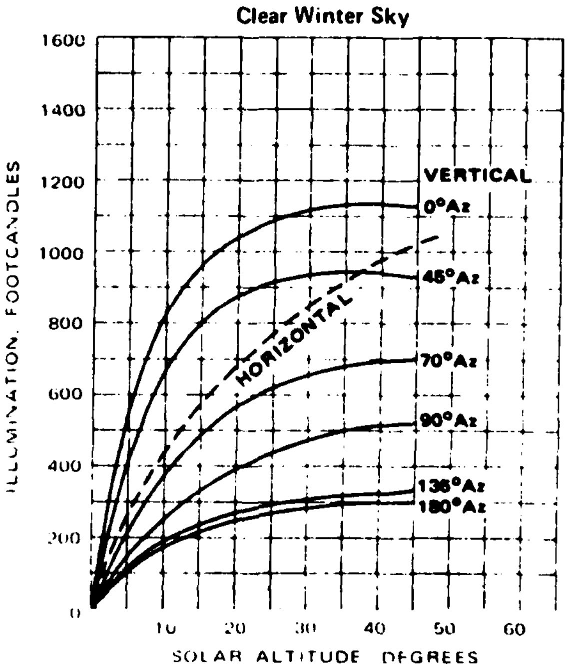


Figure 3d: Illuminance from a clear winter sky (no sun)

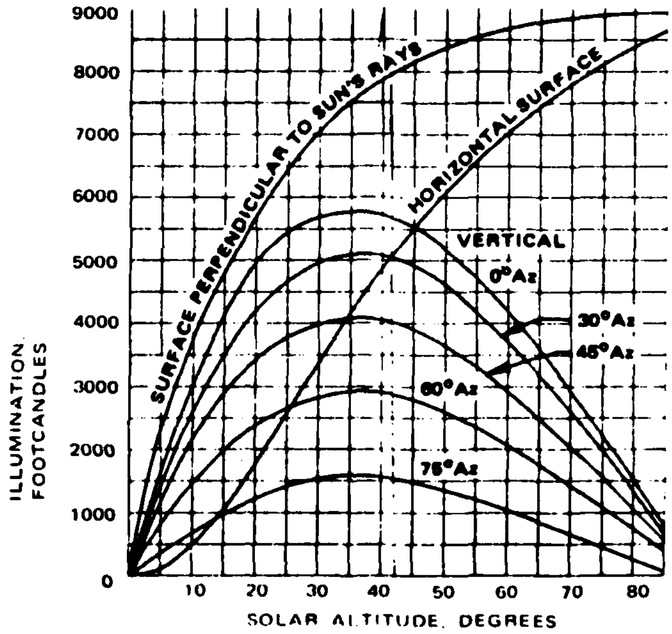


Figure 3e: Illuminance from the sun only (no sky)

4. Comparison with RP-5

IES Publication RP-5 presents an alternative method for predicting the effects of daylight. Figures 4a thru 4v compare results obtained from the CU tables presented here with those obtained from the RP-5 method. The following points regarding RP-5 calculations must be noted:

1) RP-5 assumes that the window begins 3' above the floor and runs to the ceiling. In order to achieve a window height of 10' a room height = 13' was used in the RP-5 calculations; this required interpolation between tabulated coefficients at heights 12' and 14'.

2) RP-5 tabulates coefficients only for wall reflectances 30% and 70%. Interpolation is therefore necessary to predict illuminance for 50% wall reflectance.

3) DAYCU2 computes coefficients for illuminance on the floor. RP-5 CU's give coefficients for a target plane 6" below the bottom of the window. Also, the DAYCU predictions are for an effective target plane reflectance = 30%; those from RP-5 are for effective target plane reflectance = 25-28%, depending on room dimensions (calculations from IES Handbook).

4) The room dimensions given in the comparisons presume that the W dimension corresponds to the window-wall. Note that this W dimension is the "length" dimension in RP-5; the L dimension in the comparison corresponds to "width" in RP-5.

5) The tables given in Appendix T are for ceiling reflectance 70%. The RP-5 figures are for ceiling reflectance 80%. Therefore for purposes of this comparison, abridged tables for 80% ceiling reflectance were generated; these abridged tables are included in this section following the comparison curves.

Figures 4a thru 4p are for rooms having no venetian blinds. The solid curve in each figure is a graph of the illuminance on the floor as predicted by the DAYCU2 tables. The vertical axis is illuminance in fc; the horizontal axis is distance (in feet) from the window. In each case the curve was hand-drawn from the predicted illuminance at the 5 target points treated in the tables. The heavy dots on each curve are the points from which the curves are constructed. For comparison purposes, RP-5 predicted values are plotted individually as + signs. Illuminance at the target points is computed assuming that the vertical illuminance on the window is 1000 fc. Transmittance of the window glazing is assumed to be 100%.

The Vertical/Horizontal illuminance ratios used to correspond to the RP-5 skies are:

Overcast sky:	0.75 V/H
Uniform sky:	1.00 V/H
Clear sky:	1.25 V/H

Figures 4q-4v compare predicted results when venetian blinds are present. All 6 figures are for the following conditions:

20' L x 20' W x 10' H	Room dimensions
0°	Solar azimuth angle (relative to window-wall)
45°	Solar altitude angle (therefore profile angle is also 45°)
Clear	Sky distribution (= 1.25 Vertical / Horizontal for DAYCU2)
5500 fc	Vertical illuminance from sun (RP-5)
1480 fc	" " " sky (RP-5)
1000 fc	" " " ground

The DAYCU2 curves were constructed using 50% blinds reflectance; the actual blinds reflectance from RP-5 is unknown.

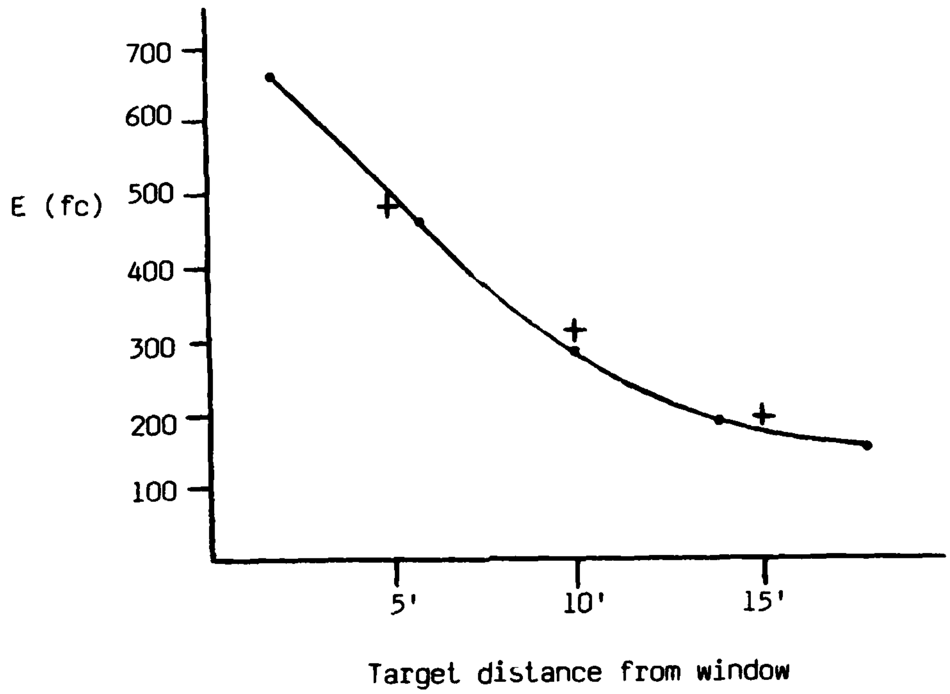


Figure 4a: 20'L x 20'W x 10'H room. Source: Uniform Sky

Figure 4b: 20'L x 20'W x 10'H room. Source: Clear sky

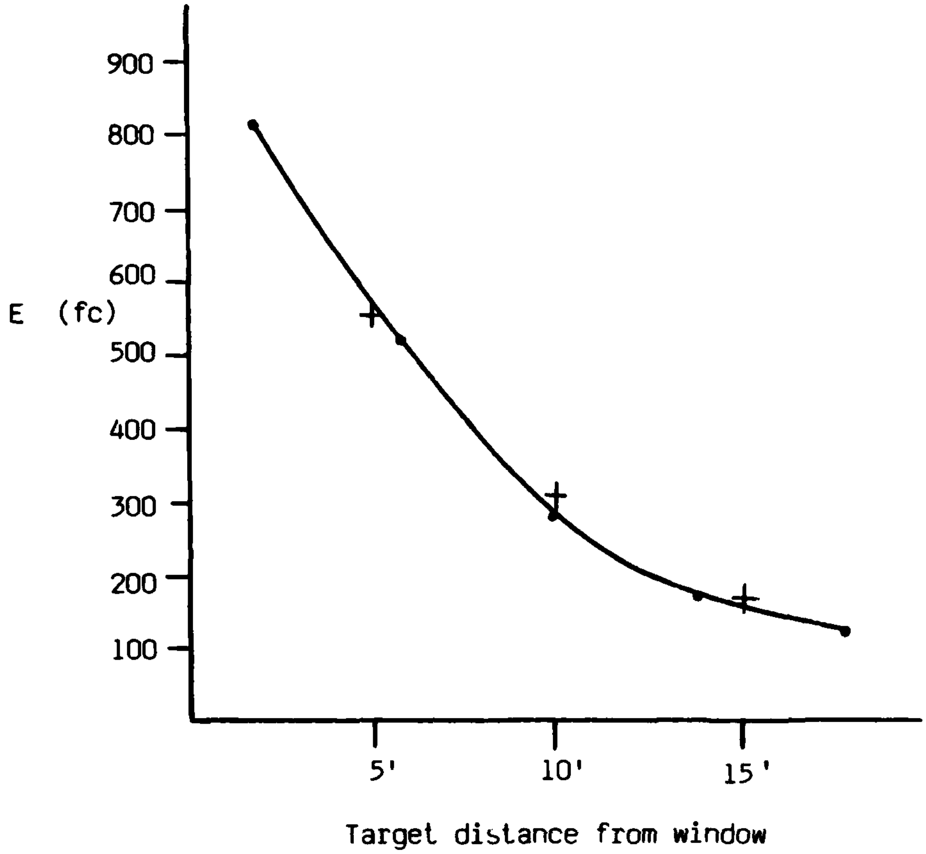


Figure 4c: 20'L x 20'W x 10'H room. Source: Overcast sky

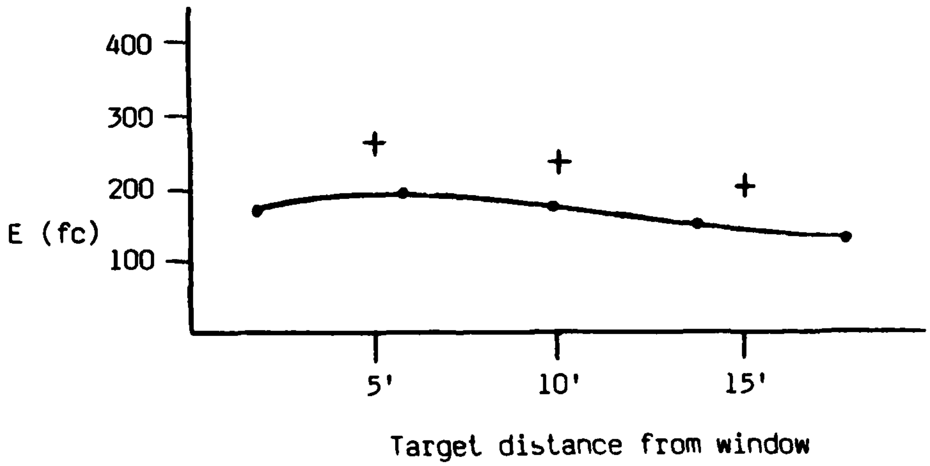


Figure 4d: 20'L x 20'W x 10'H room. Source: Ground

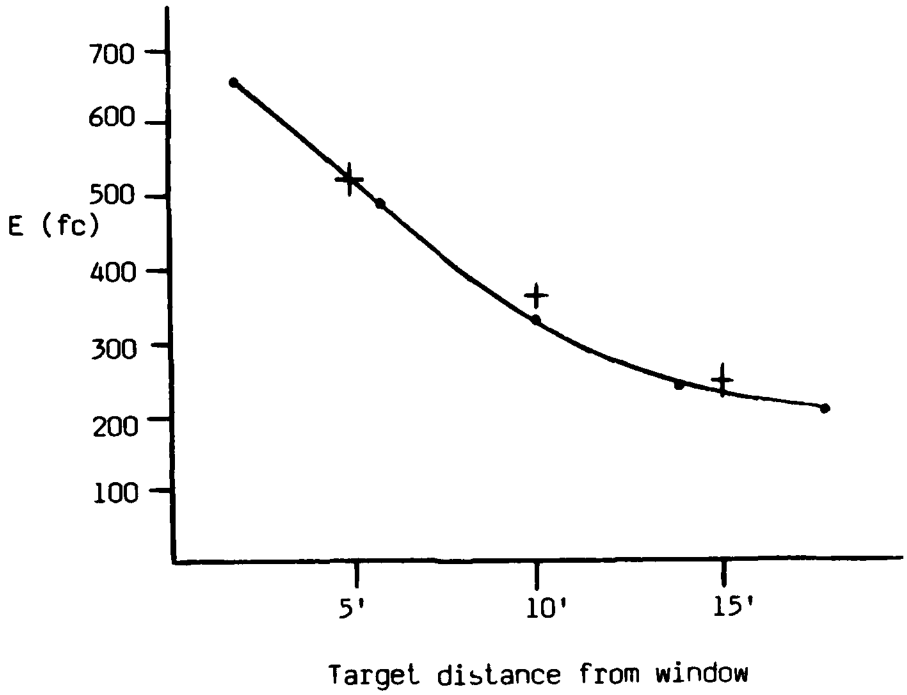


Figure 4e: 20'L x 40'W x 10'H room. Source: Uniform sky

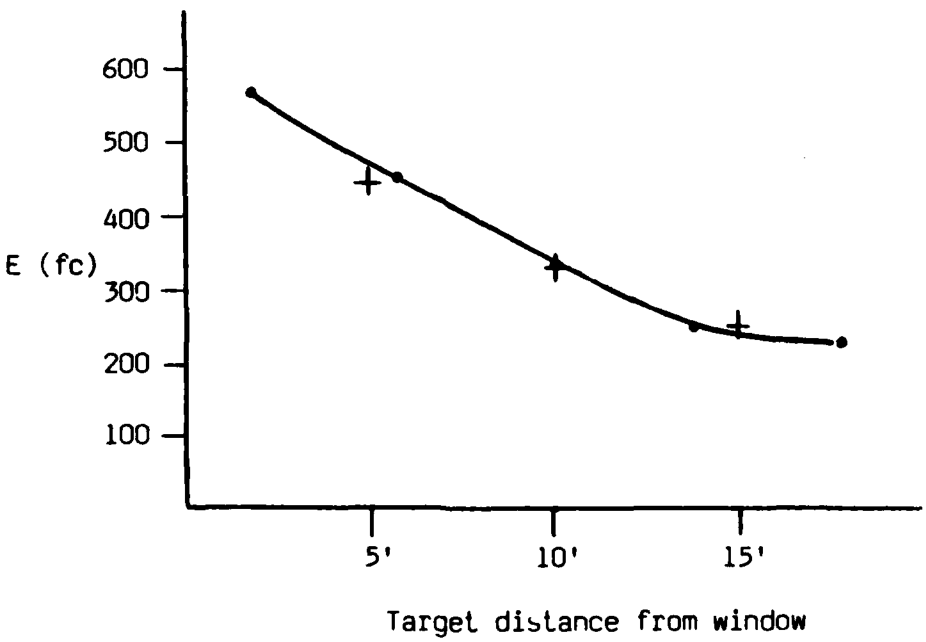


Figure 4f: 20'L x 40'W x 10'H room. Source: Clear sky

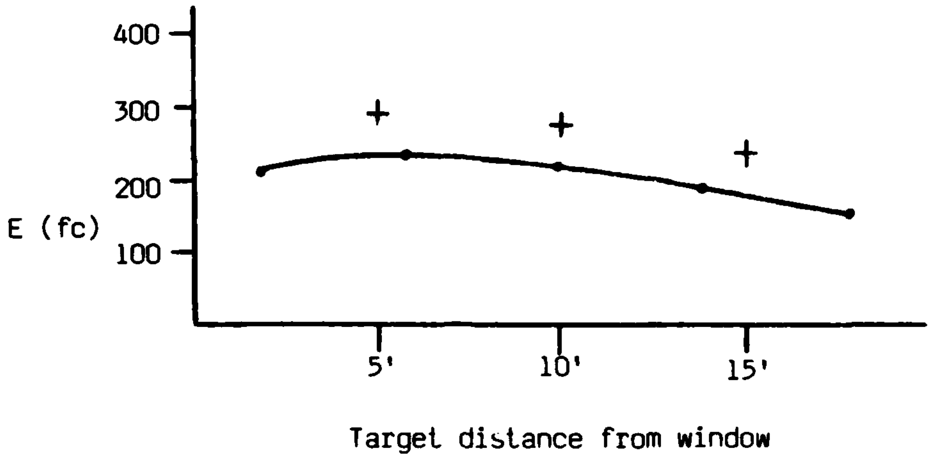


Figure 4g: 20'L x 40'W x 10'H room. Source: Ground

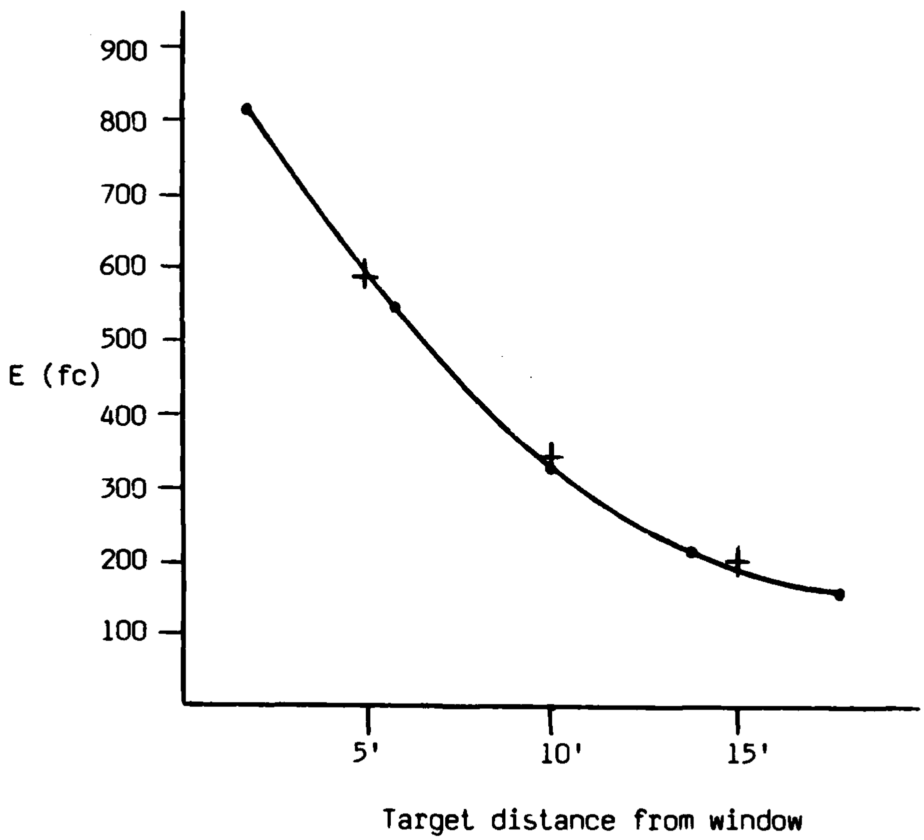


Figure 4h: 20'L x 40'W x 10'H room. Source: Overcast sky

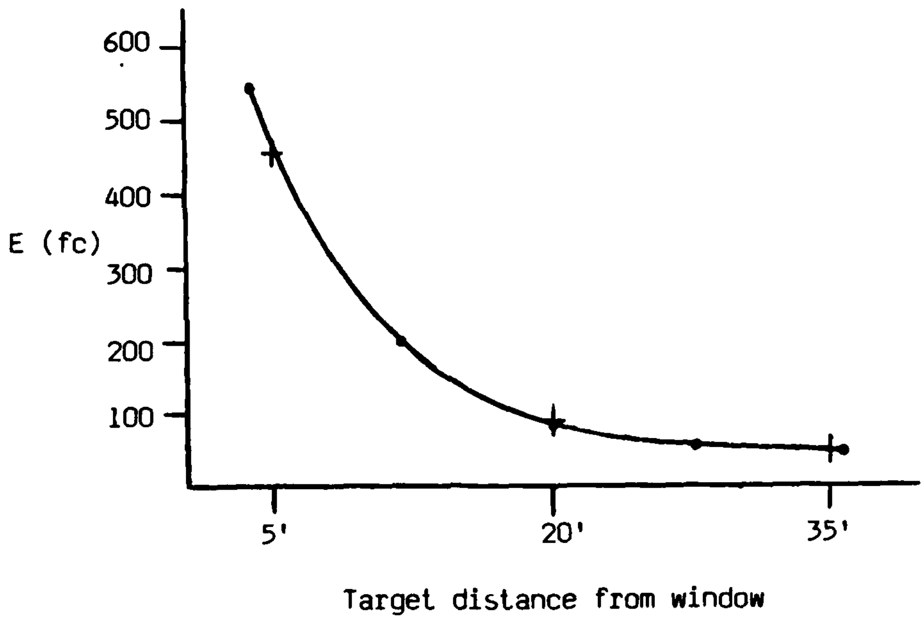


Figure 4i: 40'L x 20'W x 10'H room. Source: Uniform sky

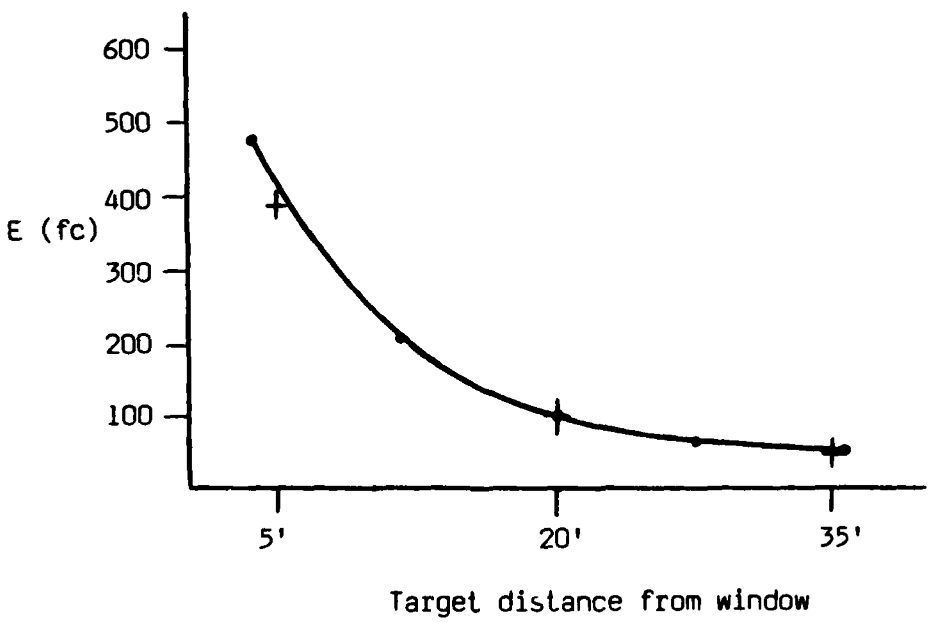


Figure 4j: 40'L x 20'W x 10'H room. Source: Clear sky

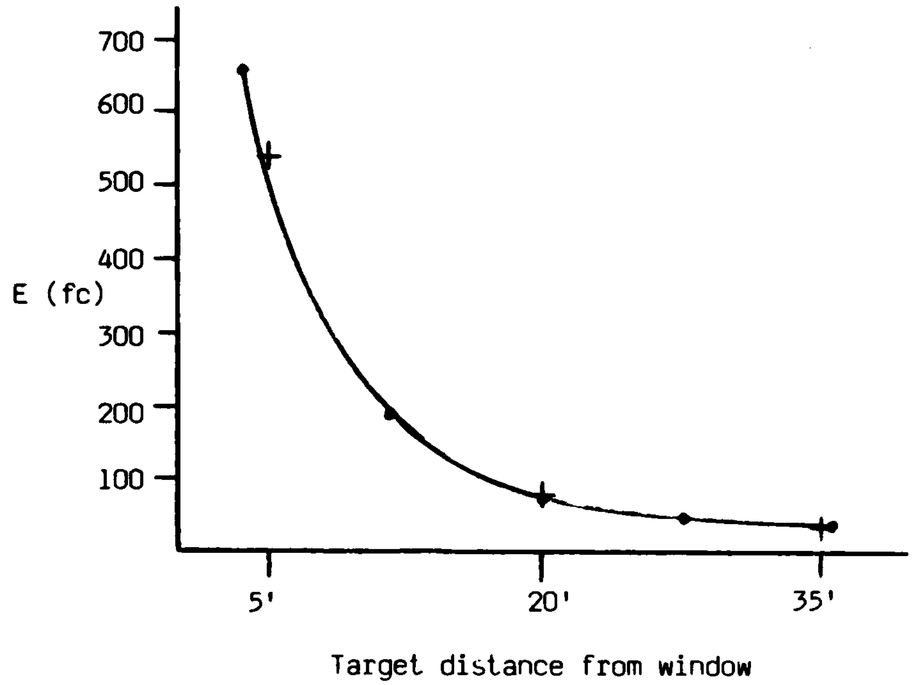


Figure 4k: 40'L x 20'W x 10'H room. Source: Overcast sky

Figure 4ℓ: 40'L x 20'W x 10'H room. Source: Ground

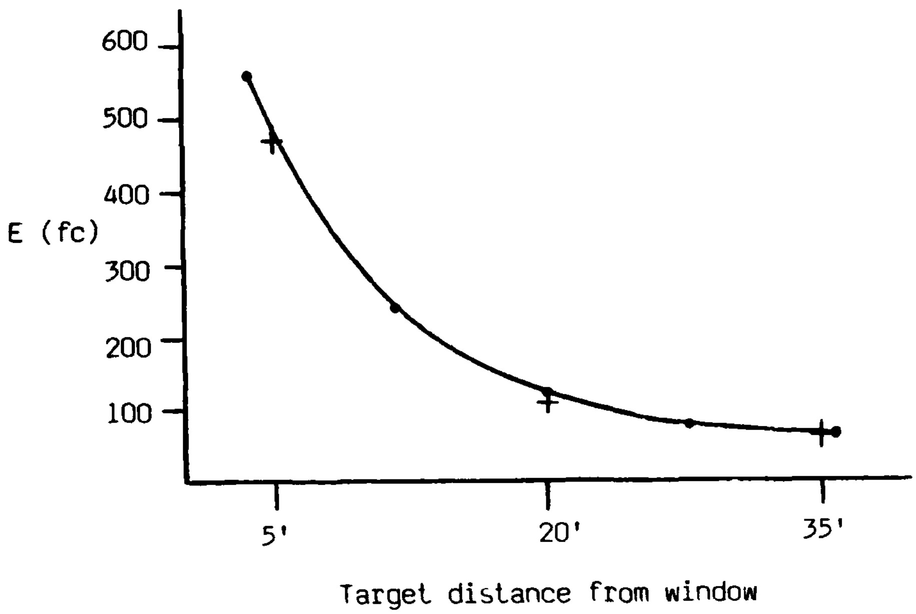


Figure 4m: 40'L x 40'W x 10'H room. Source: Uniform sky

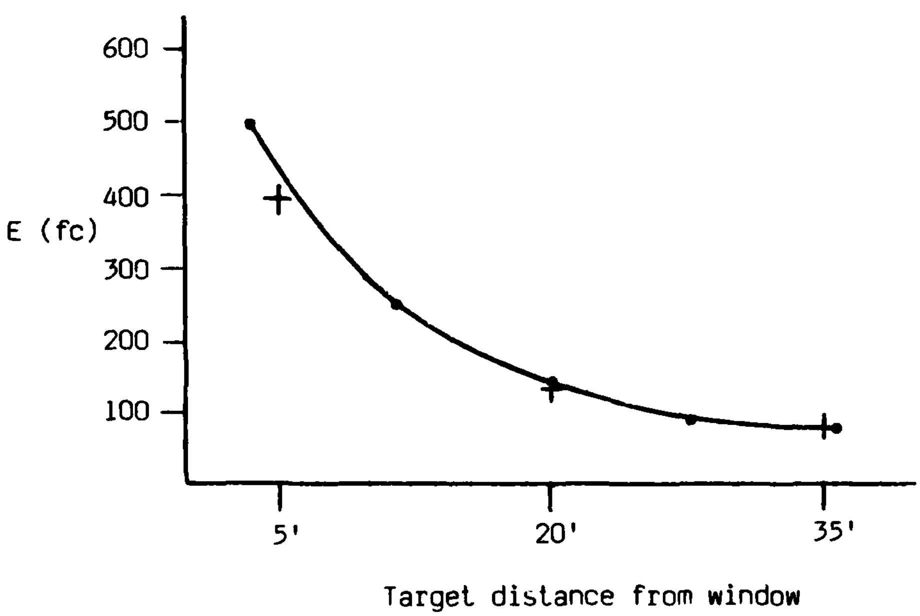


Figure 4n: 40'L x 40'W x 10'H room. Source: Clear sky

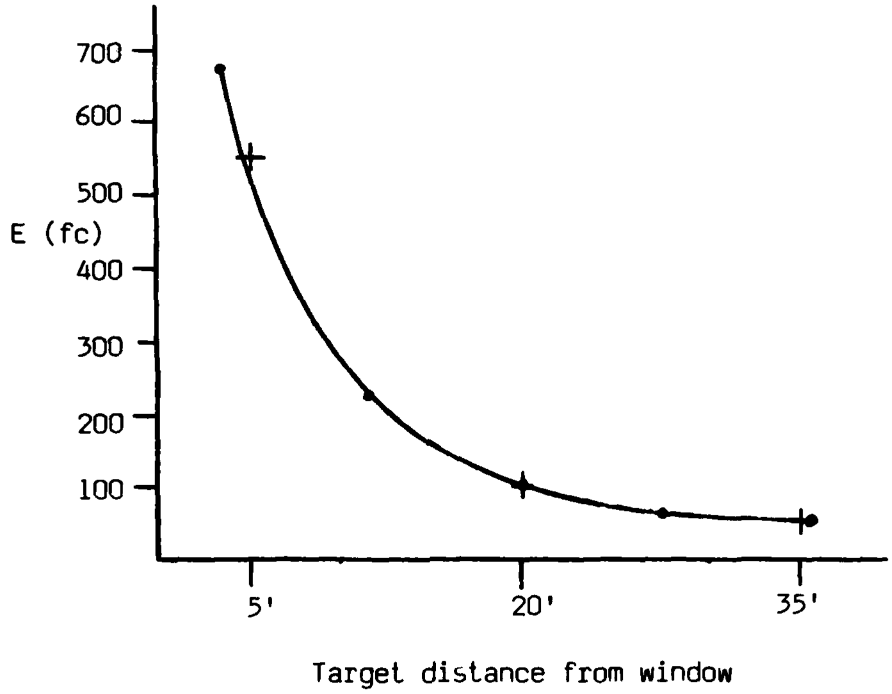


Figure 4o: 40'L x 40'W x 10'H room. Source: Overcast sky

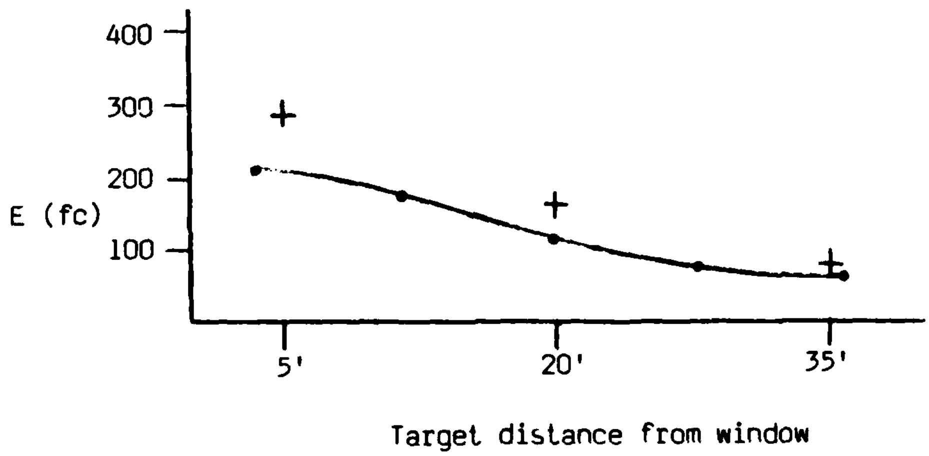


Figure 4p: 40'L x 40'W x 10'H room. Source: Ground

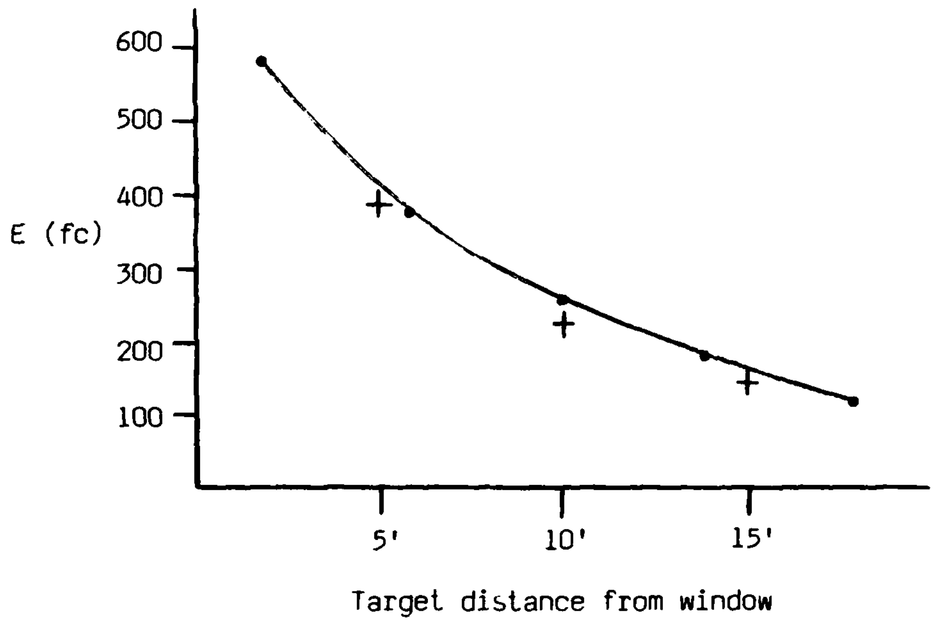


Figure 4q: Blinds setting = 30°. Source: Sun + sky

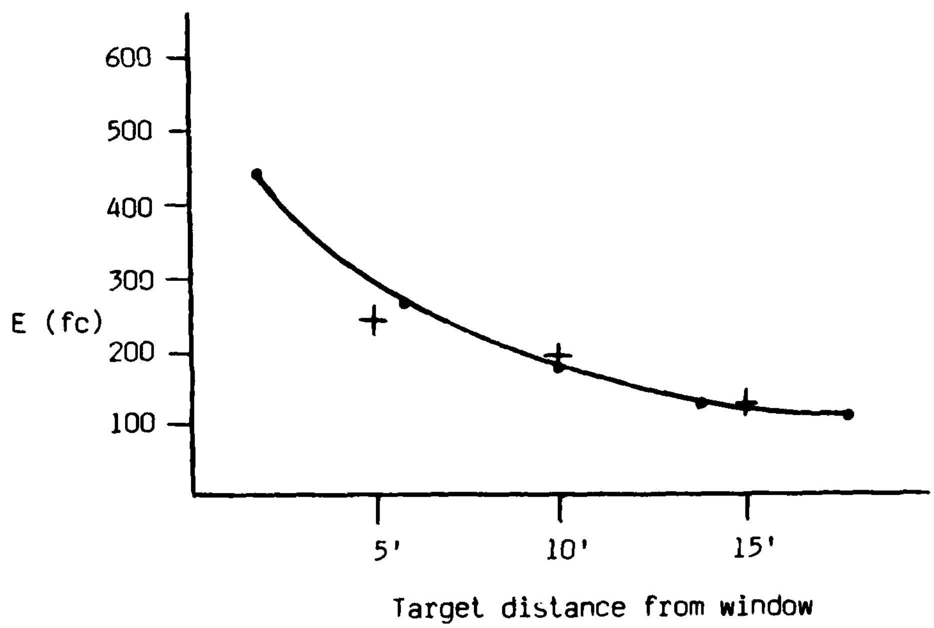


Figure 4r: Blinds setting = 45°. Source: Sun + sky

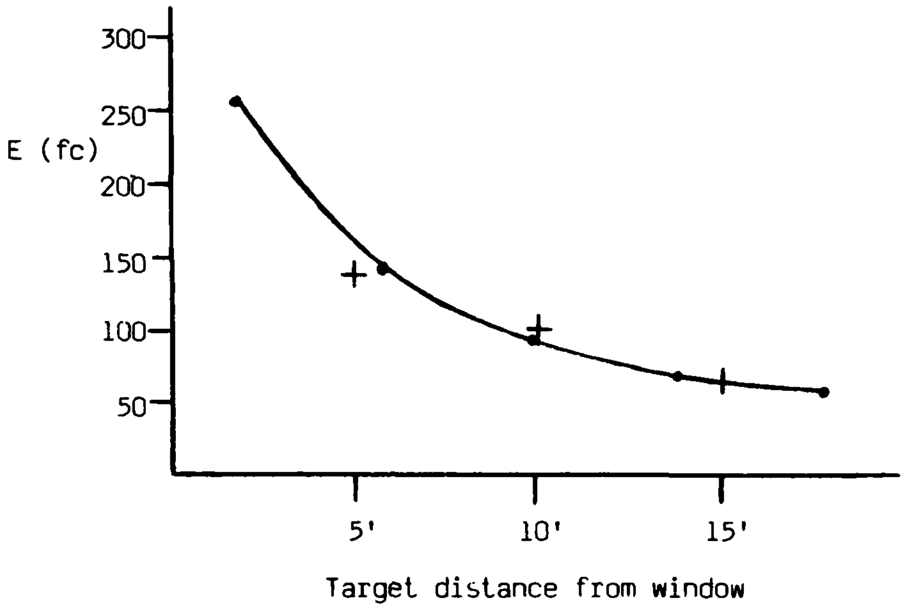


Figure 4s: Blinds setting = 60^{0}. Source: Sun + sky

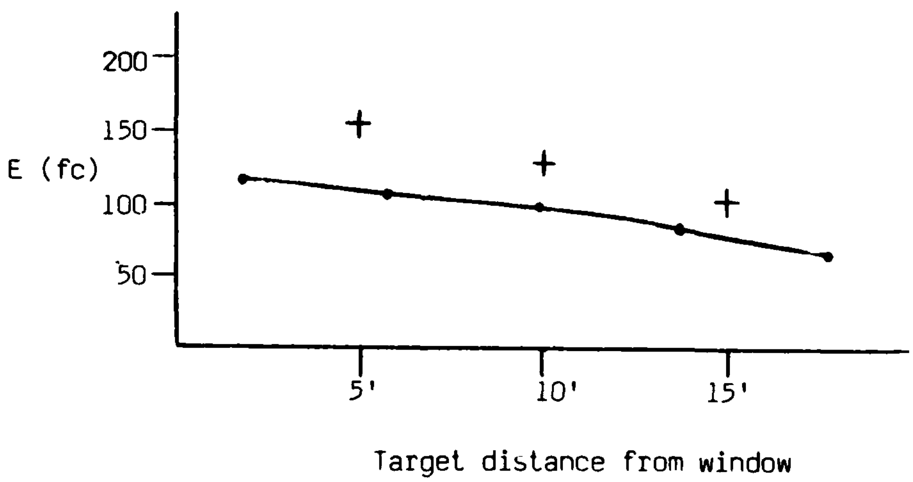


Figure 4t: Blinds setting = 30^{0}. Source: Ground

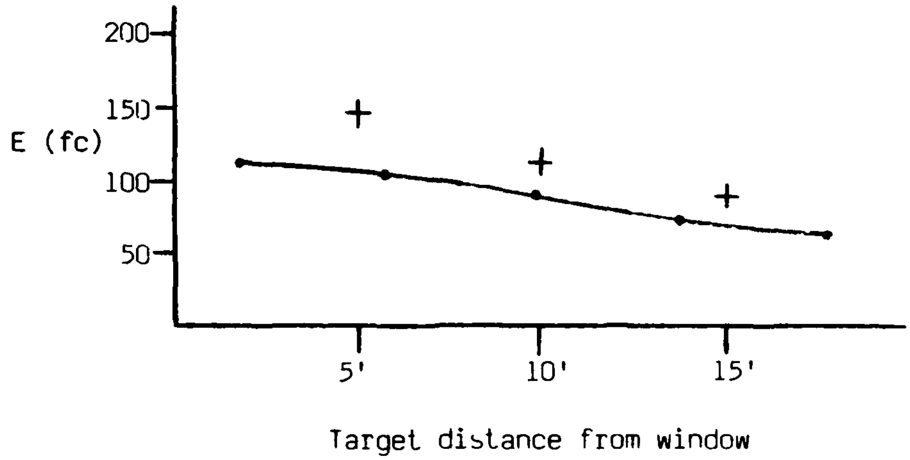


Figure 4u: Blinds setting = 45°. Source: Ground

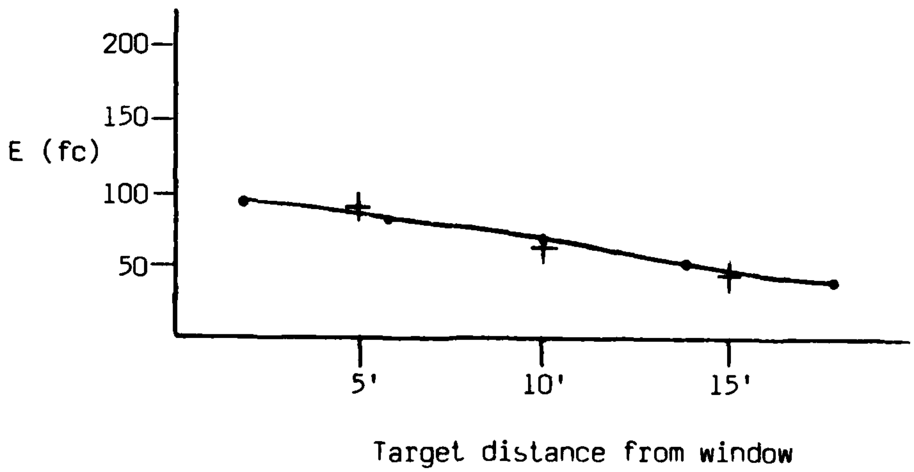


Figure 4v: Blinds setting = 60°. Source: Ground

* * * Ceiling Reflectance = 80% * * *

ILLUMINANCE FROM SKY -- V/H = 0.75
NO BLINDS

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	809	812	813	000	000	000
	30	000	000	519	544	551	000	000	000
2	50	000	000	287	319	331	000	000	000
	70	000	000	173	201	214	000	000	000
	90	000	000	127	151	164	000	000	000
	10	000	000	739	746	747	000	000	000
	30	000	000	320	350	360	000	000	000
3	50	000	000	139	163	174	000	000	000
	70	000	000	081	097	106	000	000	000
	90	000	000	061	074	082	000	000	000
	10	000	000	658	670	673	000	000	000
	30	000	000	197	224	235	000	000	000
4	50	000	000	078	094	104	000	000	000
	70	000	000	048	059	065	000	000	000
	90	000	000	040	048	053	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

* * * Ceiling reflectance = 80% * * *

ILLUMINANCE FROM SKY -- V/H = 1.00 (UNIFORM SKY)
NO BLINDS

ROOM DEPTH / WINDOW HEIGHT D / H	% D	.5	1	2	3	4	6	8	INF
		WINDOW WIDTH / WINDOW HEIGHT							W / H
1	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
2	10	000	000	658	660	661	000	000	000
	30	000	000	459	484	491	000	000	000
	50	000	000	286	320	335	000	000	000
	70	000	000	192	226	243	000	000	000
	90	000	000	156	188	207	000	000	000
3	10	000	000	607	613	614	000	000	000
	30	000	000	306	337	348	000	000	000
	50	000	000	155	183	197	000	000	000
	70	000	000	098	119	132	000	000	000
	90	000	000	079	098	110	000	000	000
4	10	000	000	549	560	563	000	000	000
	30	000	000	204	234	247	000	000	000
	50	000	000	094	114	126	000	000	000
	70	000	000	061	074	083	000	000	000
	90	000	000	050	061	070	000	000	000
6	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
8	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
10	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** Ceiling reflectance = 80% ***

ILLUMINANCE FROM SKY -- V/H = 1.25
NO BLINDS

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	566	569	570	000	000	000
	30	000	000	422	447	456	000	000	000
2	50	000	000	285	321	337	000	000	000
	70	000	000	204	242	261	000	000	000
	90	000	000	174	211	233	000	000	000
	10	000	000	527	533	534	000	000	000
	30	000	000	298	329	341	000	000	000
3	50	000	000	165	195	211	000	000	000
	70	000	000	109	132	147	000	000	000
	90	000	000	090	112	127	000	000	000
	10	000	000	484	494	497	000	000	000
	30	000	000	209	240	255	000	000	000
4	50	000	000	104	126	140	000	000	000
	70	000	000	068	083	094	000	000	000
	90	000	000	056	070	080	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** Ceiling reflectance = 80% ***

ILLUMINANCE FROM GROUND
NO BLINDS

ROOM DEPTH / WINDOW HEIGHT		WINDOW WIDTH / WINDOW HEIGHT							W / H
D / H	% D	.5	1	2	3	4	6	8	INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	178	200	209	000	000	000
	30	000	000	198	224	238	000	000	000
2	50	000	000	182	210	225	000	000	000
	70	000	000	155	182	198	000	000	000
	90	000	000	128	153	167	000	000	000
	10	000	000	175	197	207	000	000	000
	30	000	000	171	197	211	000	000	000
3	50	000	000	126	150	164	000	000	000
	70	000	000	093	111	123	000	000	000
	90	000	000	076	090	100	000	000	000
	10	000	000	172	196	208	000	000	000
	30	000	000	141	166	180	000	000	000
4	50	000	000	087	104	115	000	000	000
	70	000	000	059	071	079	000	000	000
	90	000	000	050	059	065	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** Ceiling reflectance = 80% ***

ILLUMINANCE FROM SKY -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 30

ROOM DEPTH / WINDOW HEIGHT		WINDOW WIDTH / WINDOW HEIGHT							W / H
D / H	% D	.5	1	2	3	4	6	8	INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	015	000	000	000	000	000
	30	000	000	026	000	000	000	000	000
2	50	000	000	025	000	000	000	000	000
	70	000	000	022	000	000	000	000	000
	90	000	000	021	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
3	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** Ceiling reflectance = 80% ***

ILLUMINANCE FROM SKY -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 45

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	004	000	000	000	000	000
	30	000	000	006	000	000	000	000	000
2	50	000	000	006	000	000	000	000	000
	70	000	000	005	000	000	000	000	000
	90	000	000	005	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
3	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** Ceiling reflectance = 80% ***

ILLUMINANCE FROM SKY -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 60

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
2	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
3	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** Ceiling reflectance = 80% ***

ILLUMINANCE FROM GROUND -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 30

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	074	000	000	000	000	000
	30	000	000	087	000	000	000	000	000
2	50	000	000	088	000	000	000	000	000
	70	000	000	078	000	000	000	000	000
	90	000	000	062	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
3	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** ceiling reflectance = 80% ***

ILLUMINANCE FROM GROUND -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 45

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	079	000	000	000	000	000
	30	000	000	087	000	000	000	000	000
2	50	000	000	082	000	000	000	000	000
	70	000	000	067	000	000	000	000	000
	90	000	000	052	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
3	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** ceiling reflectance = 80% ***

ILLUMINANCE FROM GROUND -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 60

ROOM DEPTH / WINDOW HEIGHT		WINDOW WIDTH / WINDOW HEIGHT							W / H
D / H	% D	.5	1	2	3	4	6	8	INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	072	000	000	000	000	000
	30	000	000	072	000	000	000	000	000
2	50	000	000	060	000	000	000	000	000
	70	000	000	046	000	000	000	000	000
	90	000	000	035	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
3	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** ceiling reflectance = 80% ***

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
HORIZONTAL BLINDS, ANGLE = 30

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
1	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
2	10	000	000	624	000	000	000	000	000
	30	000	000	269	000	000	000	000	000
	50	000	000	164	000	000	000	000	000
	70	000	000	115	000	000	000	000	000
	90	000	000	095	000	000	000	000	000
3	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
4	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
6	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
8	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
10	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** ceiling reflectance = 80% ***

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
HORIZONTAL BLINDS, ANGLE = 45

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
1	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
2	10	000	000	658	000	000	000	000	000
	30	000	000	304	000	000	000	000	000
	50	000	000	197	000	000	000	000	000
	70	000	000	145	000	000	000	000	000
	90	000	000	121	000	000	000	000	000
3	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
4	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
6	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
8	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
10	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** ceiling reflectance = 80% ***

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
HORIZONTAL BLINDS, ANGLE = 60

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	695	000	000	000	000	000
	30	000	000	339	000	000	000	000	000
2	50	000	000	229	000	000	000	000	000
	70	000	000	172	000	000	000	000	000
	90	000	000	144	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
3	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** ceiling reflectance = 80% ***

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
HORIZONTAL BLINDS, ANGLE = 30

ROOM DEPTH / WINDOW HEIGHT		WINDOW WIDTH / WINDOW HEIGHT							W / H
D / H	% D	.5	1	2	3	4	6	8	INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	076	000	000	000	000	000
	30	000	000	065	000	000	000	000	000
2	50	000	000	046	000	000	000	000	000
	70	000	000	032	000	000	000	000	000
	90	000	000	025	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
3	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** ceiling reflectance = 80% ***

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
HORIZONTAL BLINDS, ANGLE = 45

ROOM DEPTH / WINDOW HEIGHT		WINDOW WIDTH / WINDOW HEIGHT							W / H
D / H	% D	.5	1	2	3	4	6	8	INF
1	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
2	10	000	000	047	000	000	000	000	000
	30	000	000	038	000	000	000	000	000
	50	000	000	026	000	000	000	000	000
	70	000	000	018	000	000	000	000	000
	90	000	000	014	000	000	000	000	000
3	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
4	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
6	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
8	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
10	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

*** ceiling reflectance = 80% ***

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
HORIZONTAL BLINDS, ANGLE = 60

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	019	000	000	000	000	000
	30	000	000	015	000	000	000	000	000
2	50	000	000	010	000	000	000	000	000
	70	000	000	007	000	000	000	000	000
	90	000	000	006	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
3	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

5. DAYCU2 Computer Program

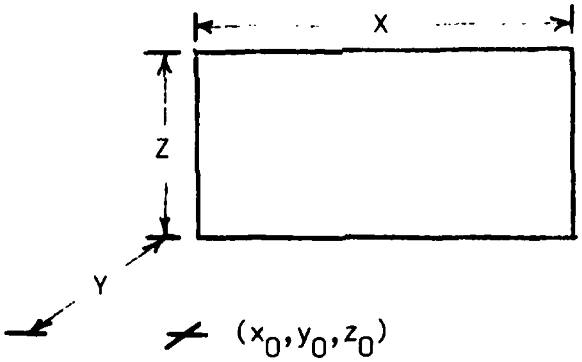
The DAYCU2 package is written in ANSI-standard FORTRAN-77 and has been implemented on the DEC VAX 11/780 minicomputer. The compiled binary code requires about 150k bytes of user memory for execution. The code consists of the three main programs DAYCU2, SUNMUL, and SKYMUL; approximately twenty additional subroutines are used. The entire source listing may be found in Appendix S.

5.1 Basic Equations

We obtain expressions for illuminance at any point in the room by starting with the inverse square law for illuminance from a point source:

$$E = \frac{cd \cos\theta}{r^2}$$

where cd = candela
θ = angle between incident ray and a normal to the surface where illuminance is being measured
r = distance from point source to target point
E = desired illuminance value



If we treat each point on the window as a point source, we can write a double integral expression to yield the illuminance at any point in the room due to the window, provided we know the brightness evident anywhere on the window. Let (x_0, y_0, z_0) be the point in the room at which we want to calculate E. The "cd" factor will always be

$\frac{L(x,z)}{\pi} \frac{Y}{r}$ where $L(x,z)$ is the brightness evident through point (x,z) on the window.

The "cosθ" factor will vary according to the room surface which the target point lies on. In addition we must account for transmission loss due to angle of incidence (see section 2.1) -- we may write this factor as $T(x,z)$. In general the expression for E is then

$$E = \int_{x_1}^{x_2} \int_{z_1}^{z_2} \frac{L(x,z)}{\pi} \frac{Y}{r} \frac{1}{r^2} \cos\theta \; T(x,z) \; dx \; dz$$

It is most convenient to perform a coordinate translation so that (x_0,y_0,z_0) becomes the origin for the integration -- this gives us these integration limits:

$$x_1 = -x_0 \qquad x_2 = X - x_0 \qquad z_1 = -z_0 \qquad z_2 = Z - z_0$$

If we wish to keep the contribution due to the sky separate from that due to the ground (which we do wish), then we evaluate two double integrals, the first with z-limits $(-z_0,0)$, the second with limits $(0,Z-z_0)$ -- these two evaluations give us the contribution from the ground and sky, respectively.

Whenever illuminance must be calculated, a 2-dimensional Simpson integration is used, with interval size chosen so that the maximum interval dimension does not exceed 0.2 times the distance from the target point to the window. In any case, however, the number of intervals cannot exceed 50 in the z-dimension, or 200 in the x-dimension.

The Simpson integrand is formed as follows:

a) $L(x,z)$ comes from the corresponding expression in 2.3, where

$$\sin h = \frac{z}{r}, \qquad r = (x^2 + Y^2 + z^2)^{\frac{1}{2}}$$

b) $T(x,z)$ comes from the expression in 2.1, with

$$\sin\psi = \frac{(x^2+z^2)}{r}, \qquad \cos\psi = \frac{Y}{r}$$

c) The $\cos\theta$ term varies with target room surface, as follows:

target surface	$\cos\theta$
west or east wall	$\frac{\lvert x \rvert}{r}$
south wall	$\frac{Y}{r}$
floor or ceiling	$\frac{\lvert z \rvert}{r}$

5.2 Handling Venetian Blinds

Following are the basic techniques used to handle venetian blinds in the program package:

1. From any point in the room at which it is necessary to compute illuminance from the window, the proportion of the exterior which is visible through the blinds is determined (Appendix D). This proportion is then used to factor the illuminance due to the blinds-free window.

2. The proportion of the exterior which is obscured by the blinds is presumed to be "replaced" by the diffuse brightness of the blinds. This process is carried out separately for both the top side of the blinds (exposed to sunlight) and the underside of the blinds (hidden from sunlight). In each case, after the final exitance of the blinds surface (topside or underside) has been determined, the total resultant flux is treated as being uniformly emitted from the entire window-wall.

   Quantitatively, the effect is easily computed by simulating the blinds effect with that of the uniform sky or ground of the same brightness as the blinds and factoring by the proportion of the window which is obscured by the blinds side in question.

3. A flux transfer analysis is used to determine the exitance on each portion of the blinds (topside and underside). The analysis accounts for the reflectance of the blinds, the initial illuminance on the blinds from sky, ground, and sun, and the blinds opening angle. The exitance determined in this fashion is exclusive of any interreflections within the room.

4. For purposes of flux transfer analysis among the surfaces of the room, a constant blinds reflectance = 50% is assumed, and the reflectance of the window-wall is then

   $.5 \sin \gamma$, where γ is the blinds opening angle

The above points should become clearer as the user goes through the step-by-step procedure in the next section and through the appendices.

5. <u>Step-by-Step Procedure</u>

This section outlines the logic flow of the program package. It may be thought of as a prose flowchart. When no blinds are present, each CU value in the table is intended to be multiplied by the vertical illuminance at the window. When blinds are present, the CU value is intended to be multiplied by the final exitance on either the underside or topside of the blinds. When DAYCU2 computes the tables, the vertical illuminance at the window is presumed to be 1000 fc; final exitance on blinds is presumed to be 1000 fL. Illuminance at each of the 5 room target points is then calculated -- these illuminance values, divided by 1000, are therefore the desired CU table entries. The procedure follows:

1. The room is assigned height = 10 feet. Length and width are then determined according to the ratios of length and width to ceiling height.

2. Each room surface (except the window-wall = north wall) is partitioned into rectangular zones of equal size. For the indirect (reflected) component calculation, each zone is treated as a diffuse light source of constant exitance. The zone sizes are chosen so that the longer dimension of any zone does not exeeed 0.2 times the largest room dimension.

3. Each zone from step 2 is assigned unit exitance; its illuminance to each of the target points is computed (see Appendix B).

4. Illuminance from the sky and ground is computed at each of
   a) every point on the room surfaces which lies at the center of a zone from step 2.
   b) each of the 5 target points on the floor.

   This illuminance is computed using 100% window transmittance and no blinds on the window. For each point, 6 values are saved:

i)	illuminance due to sky distribution	V/H = 0.75
ii)	"	1.00
iii)	"	1.25
iv)	"	1.50
v)	"	1.75
vi)	illuminance due to the ground	

   Note that i) thru v) are computed assuming ground exitance = 0; vi) is computed assuming a completely black sky. These calculations employ the integral expressions discussed in section 5.1; zenith luminance and ground exitance values used are derived in Appendix G.

5. For the later blinds calculations, auxiliary tables are derived from those of step 4. These auxiliary tables give the illuminance

at each zone center and target point due to a uniform sky of unit luminance and due to a ground of unit exitance. One pair of tables accounts for transmission loss due to angle of incidence; the other pair does not. The former is used in computing the "through" component from sky or ground; the latter are used in computing the effect of blinds exitance.

6. The flux transfer coefficients for the room in question are computed. The resulting matrix equation may then be solved for the final average exitance on each room surface, provided the initial average illuminances on each surface are known. The flux transfer matrix equation may be written:

$$\begin{bmatrix} -1 & \rho_1 F_{12} & \rho_1 F_{13} & \rho_1 F_{14} & \rho_1 F_{15} & \rho_1 F_{16} \\ \rho_2 F_{21} & -1 & \rho_2 F_{23} & \rho_2 F_{24} & \rho_2 F_{25} & \rho_2 F_{26} \\ \rho_3 F_{31} & \rho_3 F_{32} & -1 & \rho_3 F_{34} & \rho_3 F_{35} & \rho_3 F_{36} \\ \rho_4 F_{41} & \rho_4 F_{42} & \rho_4 F_{43} & -1 & \rho_4 F_{45} & \rho_4 F_{46} \\ \rho_5 F_{51} & \rho_5 F_{52} & \rho_5 F_{53} & \rho_5 F_{54} & -1 & \rho_5 F_{56} \\ \rho_6 F_{61} & \rho_6 F_{62} & \rho_6 F_{63} & \rho_6 F_{64} & \rho_6 F_{65} & -1 \end{bmatrix} \begin{bmatrix} L_1 \\ L_2 \\ L_3 \\ L_4 \\ L_5 \\ L_6 \end{bmatrix} = \begin{bmatrix} -\rho_1 E_1 \\ -\rho_2 E_2 \\ -\rho_3 E_3 \\ -\rho_4 E_4 \\ -\rho_5 E_5 \\ -\rho_6 E_6 \end{bmatrix}$$

where L_i = final (equilibrium) exitance of surface i

ρ_i = reflectance of surface i

E_i = initial illuminance on surface i

F_{ij} = form factor from surface i to surface j. See Appendix C.

Note that the F_{ij} depend only on the room geometry and hence are completely determined at this point. The ρ_i are each fixed, except for ρ_2, the reflectance of the window-wall. When no blinds are present, ρ_2 is assumed zero. Otherwise, ρ_2 varies with blinds reflectance and opening angle. Therefore at this point ρ_2 is set to 1, so that the actual row 2 of the matrix may be determined later simply by multiplying each entry in the row by the true value of ρ_2.

7. The table values for the various sky distributions and the ground are computed -- windows are unobstructed. This is done by averaging the initial illuminances at the centers of zones (from step 4). Then the flux transfer analysis described in step 6 may be performed to yield the final average exitance on each room surface.

The individual zone brightnesses are then adjusted in a manner consistent with both the initial illuminance on each zone and the final average brightness on the room surface. Once this is done, the effect of the zones upon the target points may be calculated using the multipliers from step 3.

8. For a given blinds angle setting, the proportion of sky and ground which are visible thru the blinds from each zone center and target point are computed. For example, a sky value of .27 would mean that for the interior point in question (either a zone center or target point) .27 of the sky is visible from the point; the remaining .73 is obscured by the blinds. Appendix D discusses the determination of the visibility proportions.

   At each blinds angle, the proportion of topside (exposed to the sun) and underside (hidden from sun) of blinds is calculated.

9. For each blinds setting and type (horizontal or vertical blinds), the following tables are calculated using the proportions determined in step 8:

   Sky thru component
   Ground thru component
   Underside of Blinds component
   Topside of Blinds component

   For the sky and ground thru components, both sky and ground are presumed to produce 1000 fc vertical at the window. For the blinds tables, the exitance of both the topside and underside is assumed to be 1000 fL.

5.3 SUNMUL and SKYMUL

The solar blinds multipliers are calculated by the program SUNMUL according to the discussion in Appendix E.

The sky blinds multipliers and ground blinds multipliers are computed by the program SKYMUL according to the discussion in Appendix F.

6. Conclusions and Recommendations

It is felt that the work here has resulted in an extremely powerful tool for predicting the effect of daylight in interior spaces. The tables are easy to use, requiring only a few table lookups and simple arithmetic; at the same time the tables are reasonably compact while spanning a wide range of conditions.

The DAYCU2 package should prove itself to be a very versatile research tool, since with minor modification it can permit the analysis of hypotheses which might possibly condense the total information into fewer tables or even a series of analytic formulae. The package might also be used to generate tables for other daylighting conditions, such as wall reflectance other than 50%.

The following paragraphs discuss some recommendations and provisos regarding the use of the tables:

6.1 Venetian Blinds and Direct Sunlight

When a strong solar illuminance is present on the window, extra care is called for when applying the CU tables. Since the sun will produce the dominant illuminating effect within the room any tolerances in assumptions or application will magnify themselves in the predicted result.

In particular the user should be careful to ascertain the actual reflectance of the blinds. He should also be mindful of the presumption within the tables of perfectly flat blinds slats. If the slats show substantial curvature the CU tables' predictions are likely to be optimistic. Also, if the blinds surfaces are not predominantly diffusing, substantial deviation is likely between reality and predicted result.

Finally, it is worth stressing that the tables assume that no direct sunlight enters the room. Therefore the CU tables' predicted result for blinds opening angle = 0^{o} and solar profile angle = 30^{o} will be substantially divergent from reality since in this case sunlight can enter the room. Other combinations of opening angle and profile angle can also result in the entry of direct sunlight into the room.

6.2 Relationship of Blinds Reflectance to CU Values

In an environment involving venetian blinds, it seems that the illuminance at a target point would be proportional to the exitance of the blinds. This is approximately true, with a few provisos. First, the daylight entering the room between blinds slats must be accounted for separately. Secondly, and more subtly,

a change in blinds reflectance will influence the interreflection calculations among the room surfaces. Since some of this interreflected light will have originated as daylight passing between blinds slats, its effect will muddle the relationship between the exitance of the blinds and the illuminance at the target points.

If we substract the effect of daylight entering between blinds slats and if we ignore the effect of the blinds reflectance on subsequent interreflections involving this directly-entering daylight, we may examine the following hypothesis:

"The illuminance E at a target point which is due only to flux reflected from blinds" is proportional to the exitance of the blinds."

To make use of this hypothesis we note from Appendix F that the exitance L on blinds is

$$L = \rho \left[\frac{E_1 + \rho E_2 F_{12}}{1 - \rho^2 F_{12}^2} \right]$$

If the illuminance is coming either from the sun or the sky, then $E_1 = 0$ and for given blinds opening angle the numerator is proportional to ρ^2. For 100% blinds reflectance the denominator has the minimum value $1 - .4^2$ [approximately] = .84 For reflectance 70% the denominator has minimum value approx. $1 - .7^2.4^2 = .92$ These minima are for opening angles of 0 degrees. For other opening angles the form factor F_{12} decreases, so that the denominator increases toward 1.

Since the denominator will be close to 1 in most cases of interest, we may state that the illuminance at the target points due to the exitance of the blinds will be approximately proportional to the square of the reflectance of the blinds, except for ground light, where E_1 is not zero.

6.3 Window Smaller than Entire Wall

In many if not most applications the window will not occupy the entire wall. In such cases the illuminance values predicted from the CU tables should be adjusted downward by the fraction of wall area which is occupied by window. For example, if the window is 5' x 8' and lies on a 30' x 10' wall, the proportion of wall area occupied by window is (40/300) = 0.133... The predicted target point illuminances should be multiplied by 0.133... If more than one window lies on the wall then their cumulative area is used in determining the factor; only a single application of the CU tables is necessary.

For windows centered on the wall, the CU predictions should be pessimistic when compared to reality; when the windows tend toward room corners, the CU predictions should be optimistic.

6.4 Windows on More than One Wall

Where more than one wall has windows, the CU tables should be applied separately for each wall which has windows; the results should be added. The user should be aware that since the CU tables assume 50% reflectance on all walls except the window-wall, the CU prediction is likely to be optimistic in cases where more than one wall has windows. However, when venetian blinds are present the actual reflectances will be closer to 50%, so the table predictions should be more accurate.

A. Computing the Solar Profile Angle

The daylighting coefficient of utilization tables presented here require the knowledge of the solar profile angle if it is desired to use the tables for an application involving horizontal venetian blinds. If vertical venetian blinds are used, the user must know the solar azimuth angle. In practice the azimuth angle will be given or easily obtained; the profile angle is computed from the known values of azimuth angle and altitude angle.

The azimuth angle is that angle between the outward normal from the window-wall and the projection of the vector from the window-wall to the sun onto the ground. The elevation angle is the angle from the horizon to the sun. The profile angle for the horizontal blinds case is that angle between the outward normal from the window-wall and the projection of the vector from the window-wall to the sun upon the vertical plane containing the outward normal.

Let ϕ = solar azimuth angle, α = solar altitude angle (= solar elevation angle)

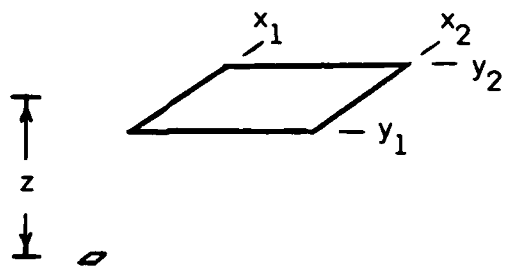
Then the profile angle β is given by

$$\beta = \tan^{-1}\left[\frac{\tan\alpha}{\cos\phi}\right]$$

B. Configuration Factors

The configuration factor C is the ratio of the illuminance at a given target point to the exitance of a Lambertian surface, provided the point is illuminated exclusively by the surface. Two cases are useful here: (1) the target point lies in a plane parallel to the surface, and (2) the target point lies in a plane normal to the surface.

B.1 Parallel Target Plane



The configuration factor C is given by

$$C = \int_{x_1}^{x_2}\int_{y_1}^{y_2} \frac{z^2}{\pi (x^2 + y^2 + z^2)^2} \, dx \, dy$$

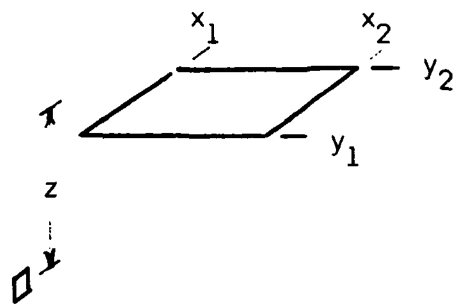
$$= \frac{1}{2\pi} \sum_{i=1}^{2} \sum_{j=1}^{2} F(x_i, y_j) \, (-1)^{i+j}$$

where

$$F(x,y) = \frac{x}{\sqrt{x^2+z^2}} \tan^{-1} \frac{y}{\sqrt{x^2+z^2}} + \frac{y}{\sqrt{y^2+z^2}} \tan^{-1} \frac{x}{\sqrt{y^2+z^2}}$$

If the exitance of the surface is L fL, then the illuminance E is simply E = LC.

B.2 Normal Target Plane



The configuration factor C is given by

$$C = \int_{x_1}^{x_2}\int_{y_1}^{y_2} \frac{x\ z}{\pi\,(x^2+y^2+z^2)^2}\ dx\ dy$$

$$= \frac{z}{2\pi} \sum_{i=1}^{2} \sum_{j=1}^{2} F(x_i, y_j)\ (-1)^{i+j}$$

where

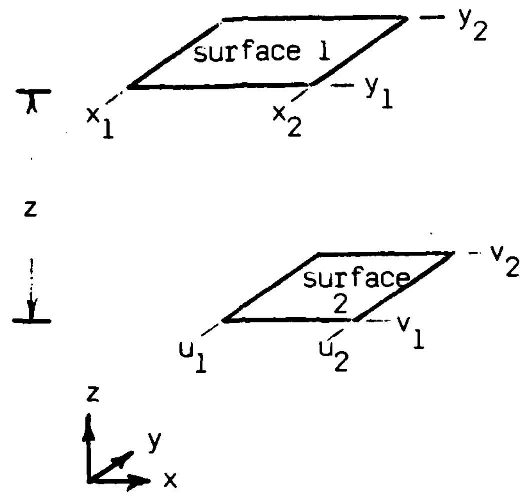
$$F(x,y) = \frac{-1}{\sqrt{x^2+z^2}} \tan^{-1} \frac{y}{\sqrt{x^2+z^2}}$$

If the exitance of the surface is L fL, then the illuminance E is simply $E = LC$.

C. Form Factors

The form factor from one surface to another is the proportion of flux leaving the first surface which is incident upon the second. The following treatments give the form factor F_{12} from surface 1 to surface 2 for the cases where the two surfaces are either parallel or normal:

C.1 Parallel Surfaces



$$F_{12} = \frac{z^2}{\pi A_1}\int_{u_1}^{u_2}\int_{v_1}^{v_2}\int_{x_1}^{x_2}\int_{y_1}^{y_2}\frac{du\ dv\ dx\ dy}{\left((x-u)^2 + (y-v)^2 + z^2\right)^2}$$

$$= \frac{z^2}{2\pi A_1}\sum_{i=1}^{2}\sum_{j=1}^{2}\sum_{k=1}^{2}\sum_{m=1}^{2} H(u_i,v_j,x_k,y_m)\ (-1)^{i+j+k+m}$$

where

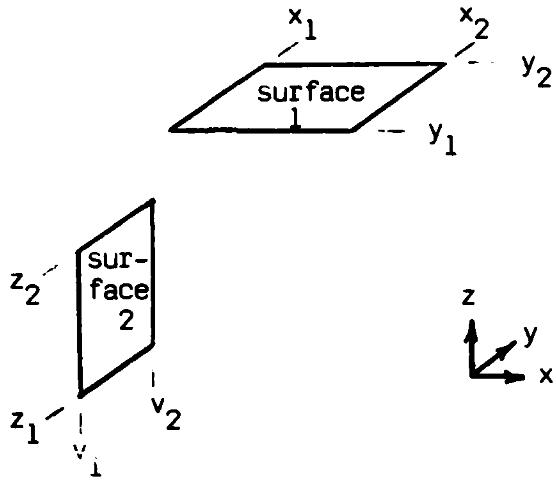
$$H(u_i,v_j,x_k,y_m) = b\sqrt{1+a^2}\tan^{-1}\frac{b}{\sqrt{1+a^2}} + a\sqrt{1+b^2}\tan^{-1}\frac{a}{\sqrt{1+b^2}} - \tfrac{1}{2}\ln\left(1+a^2+b^2\right)$$

$$a = \frac{1}{z}(x_k - u_i)$$

$$b = \frac{1}{z}(y_m - v_j)$$

A_1 = area of surface 1

C.2 Normal Surfaces



$$F_{12} = \frac{1}{\pi A_1} \int_{v_1}^{v_2}\int_{z_1}^{z_2}\int_{x_1}^{x_2}\int_{y_1}^{y_2} \frac{(x-\bar{x})\;(\bar{z}-z)\quad dv\;dz\;dx\;dy}{((x-\bar{x})^2 + (y-v)^2 + (\bar{z}-z)^2)^2}$$

$$= \frac{1}{2\pi A_1} \sum_{i=1}^{2}\sum_{j=1}^{2}\sum_{k=1}^{2}\sum_{m=1}^{2} G(v_i,z_j,x_k,y_m)\;(-1)^{i+j+k+m}$$

where

$$G(v_i,z_j,x_k,y_m) = a\sqrt{c^2+b^2}\;\tan^{-1}\frac{a}{\sqrt{c^2+b^2}} + \tfrac{1}{4}(a^2-b^2-c^2)\ln(a^2+b^2+c^2)$$

$a = y_m - v_i$

$b = \bar{z} - z_j$

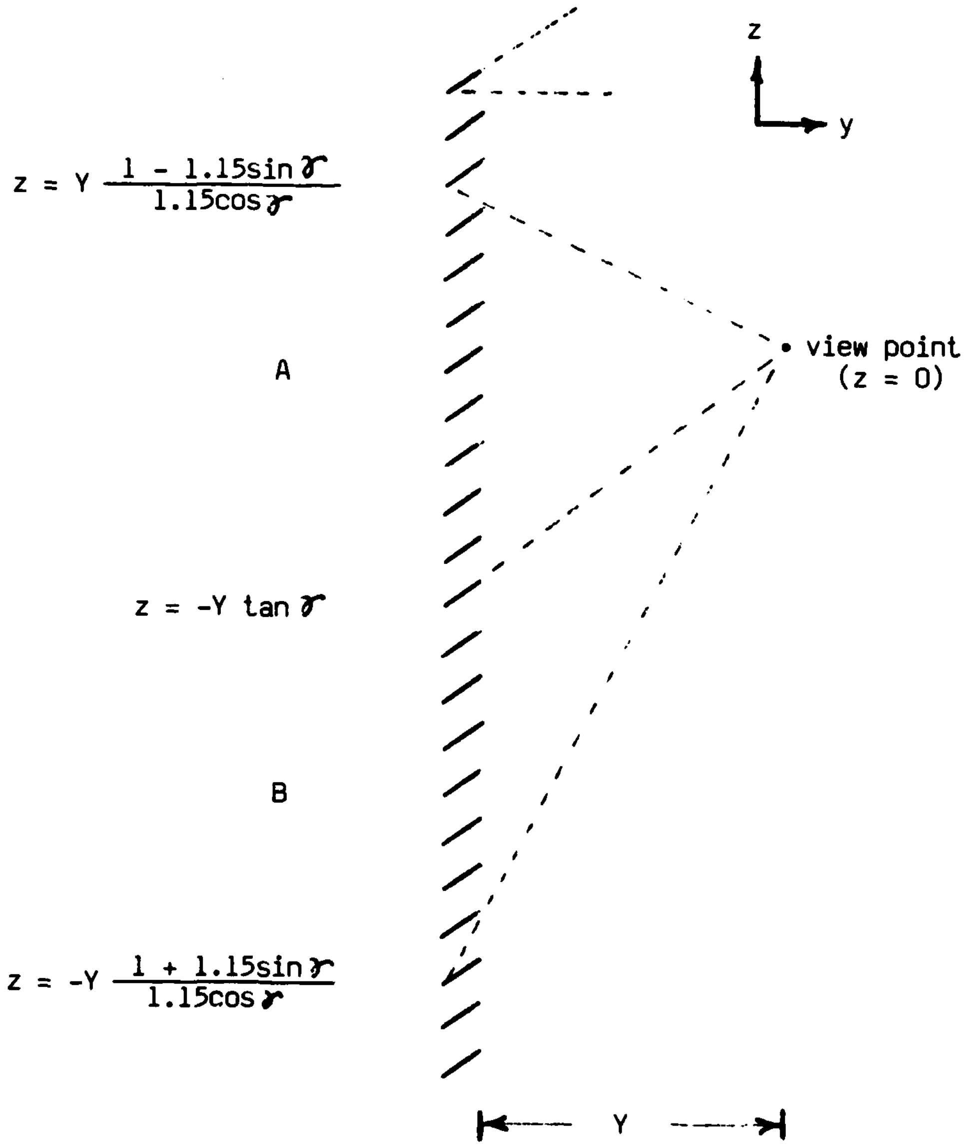
$c = x_k - \bar{x}$

A_1 = area of surface 1 = $(x_2-x_1)(y_2-y_1)$

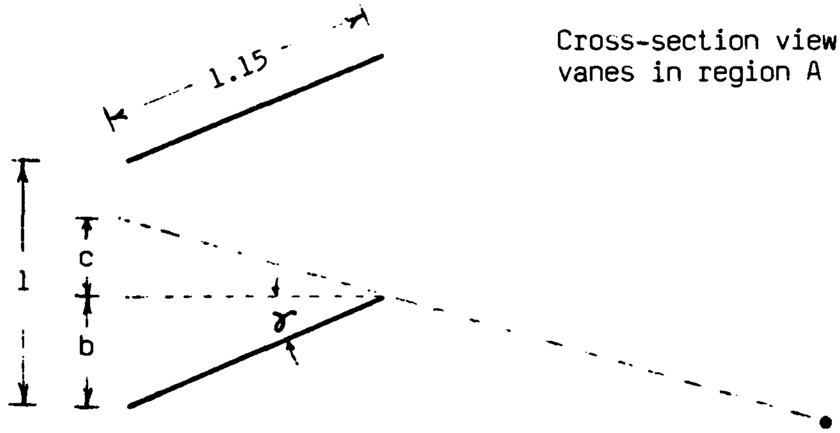
$\bar{x}$ = x-coordinate of surface 2

$\bar{z}$ = z-coordinate of surface 1

D. <u>Proportion of Sky and Ground Visible through Blinds</u>



We need to know the proportion of the outside environment (sky and ground) which is visible through venetian blinds. In the sketch above let the view point have z-coordinate zero and let its distance from the blinds be Y. γ is the opening angle of the blinds. Divide the blinds into regions, A and B, and note that above region A and below region B, nothing outside is visible from the view point. Also note that the "topside" of the blinds are visible in region B, while the "underside" are visible in region A.



Cross-section view of two blinds vanes in region A

The sketch above graphically illustrates the view position into region A. We assume that the blinds have width equal to 1.15 times their spacing and that Y is large compared to the blinds width. The proportion of the exterior which is visible is then

$$1 - b - c = 1 - 1.15 \sin\gamma - 1.15 \frac{z}{Y} \cos\gamma$$

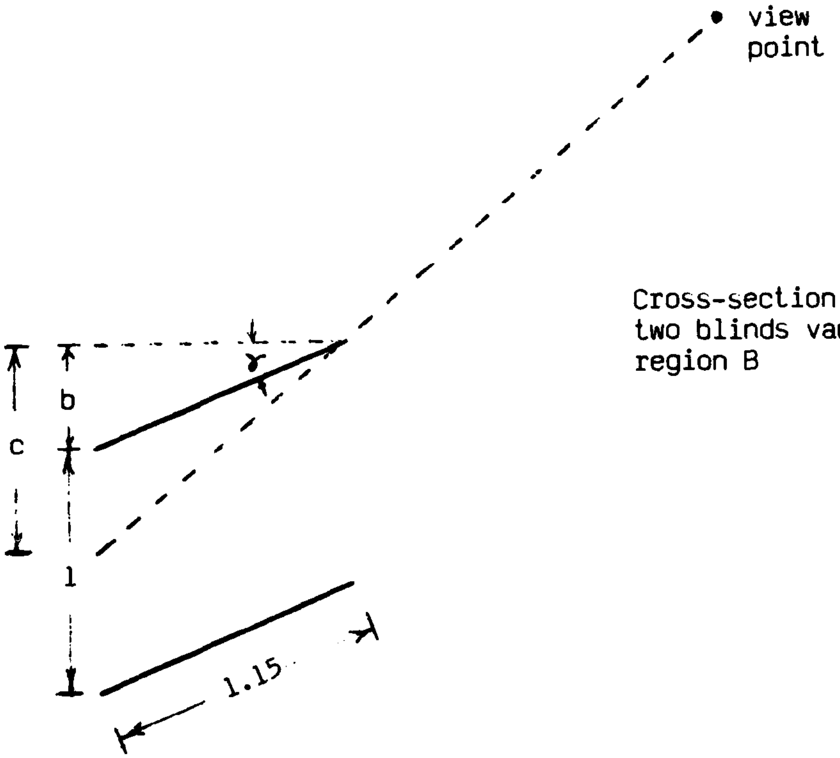
Over the entire portion of region A in question, then the proportion visible is

$$\int_{z_1}^{z_2} \left(1 - 1.15 \sin\gamma - 1.15 \frac{z}{Y} \cos\gamma\right) dz$$

$$= (1 - 1.15 \sin\gamma)(z_2 - z_1) - 1.15 \frac{\cos\gamma}{2Y} (z_2^2 - z_1^2)$$

where z_1 and z_2 are the lower and upper limits of the subset of region A in question. In practice a proportion of sky visible is computed separately from a proportion of ground. For the sky we have $z_1 = 0$ and z_2 cannot exceed $Y \dfrac{(1 - 1.15 \sin\gamma)}{1.15 \cos\gamma}$

For the ground we have $z_2 = 0$ and z_1 cannot exceed $-Y \tan\gamma$.



Cross-section view of two blinds vanes in region B

The sketch above illustrates the view position into region B. We again assume blinds width:spacing ratio = 1.15:1, and that Y is large compared to blinds width. The proportion of the exterior visible is

$$1 + b - c = 1 + 1.15 \sin\gamma + 1.15 \frac{z}{Y} \cos\gamma$$

Over the entire subset of region B in question, the proportion is

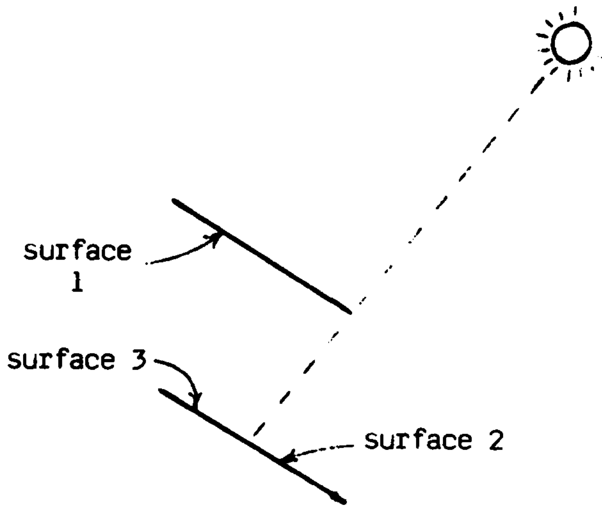
$$\int_{z_1}^{z_2} (1 + 1.15 \sin\gamma + 1.15 \frac{z}{Y} \cos\gamma)\, dz$$

$$= (1 + 1.15 \sin\gamma)(z_2 - z_1) + 1.15 \frac{\cos\gamma}{2Y}(z_2^2 - z_1^2)$$

where z_1 and z_2 are the lower and upper, respectively, limits of the subset of region B in question. Since only the ground may be visible through region B, z_1 can be no less than $-Y\left(\frac{1 + 1.15 \sin}{1.15 \cos}\right)$ and z_2 cannot exceed $-Y \tan\gamma$.

E. Exitance on Blinds due to Sunlight

Blinds are treated as being of 1.15:1 width to spacing, and infinite length. We are interested in determining the exitance on the underside and topside of each vane.



Refer to the above cross-sectional view of 2 adjacent vanes. In general, the sunlight will only strike a portion of the lower vane. Therefore, the required exitances are determined by a three-surface flux-transfer analysis. Surface 2 is that portion of the lower vane which receives sunlight; surface 3 is the remaining portion of the lower vane. The flux transfer equations in matrix form are:

$$\begin{bmatrix} -1 & \rho F_{12} & \rho F_{13} \\ \rho F_{21} & -1 & 0 \\ \rho F_{31} & 0 & -1 \end{bmatrix} \begin{bmatrix} L_1 \\ L_2 \\ L_3 \end{bmatrix} = \begin{bmatrix} -\rho E_1 \\ -\rho E_2 \\ 0 \end{bmatrix}$$

We solve for each L_i using Cramer's Rule:

$$L_1 = \rho \left[\frac{E_1 + \rho F_{12} E_2}{1 - \rho^2 F_{13} F_{31} - \rho^2 F_{12} F_{21}} \right]$$

$$L_2 = \rho \left[\frac{E_2 + \rho E_1 F_{21} - \rho^2 E_2 F_{13} F_{31}}{1 - \rho^2 F_{13} F_{31} - \rho^2 F_{12} F_{21}} \right]$$

$$L_3 = \rho^2 \left[\frac{E_1 F_{31} + E_2 F_{12} F_{31}}{1 - \rho^2 F_{13} F_{31} - \rho^2 F_{12} F_{21}} \right]$$

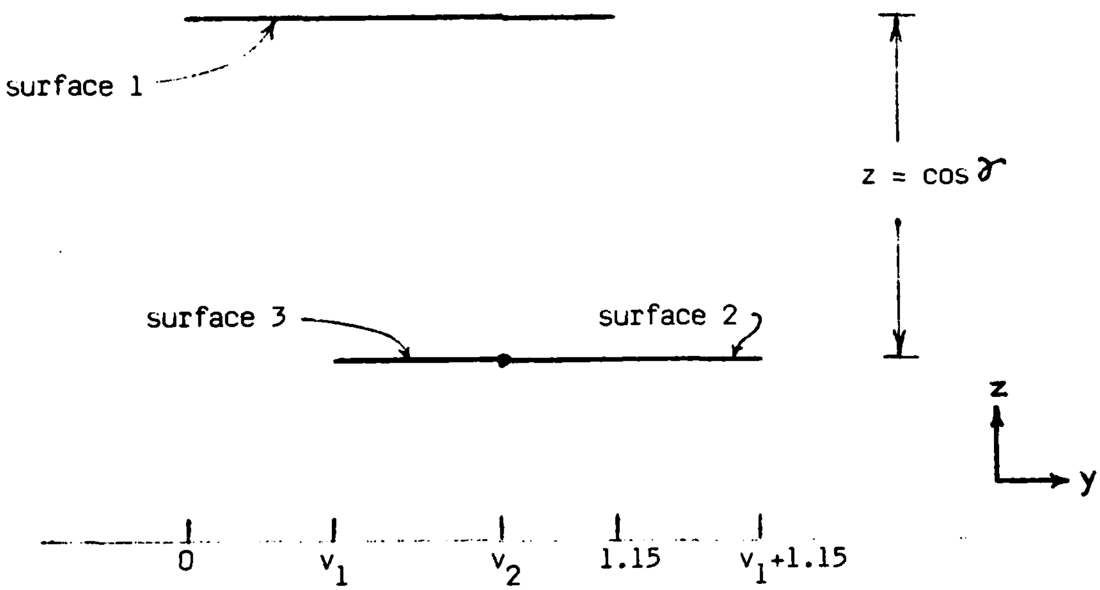
where ρ = reflectance of blinds

F_{ij} = form factors

L_i = final (equilibrium) exitance of the three surfaces

E_i = initial illuminance on the surfaces from direct sunlight

It remains to determine the F_{ij} form factors. Refer to the figure below:

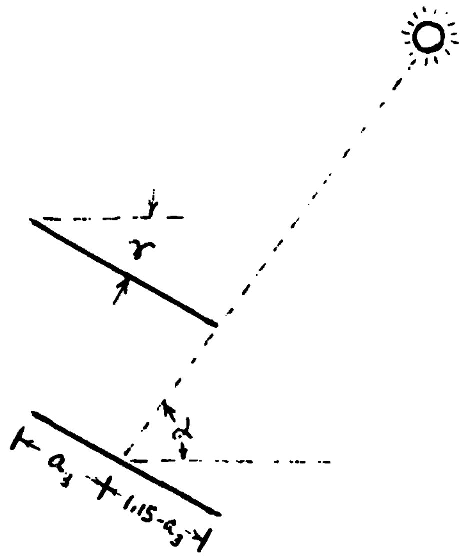


Determination of the form factors F_{12} and F_{13} are special cases of the general formulae which are given in section C.1 . Here we have $y_1 = 0$ and $y_2 = 1.15$, with x_1 and u_1 running to negative infinity, and x_2 and u_2 running to positive infinity.

The v-limits are as shown in the sketch above; note that $v_1 = \sin\gamma$ where γ is the blinds opening angle. Evaluating the general-case integral expression for parallel-surface form factors and taking the limits as the x and u limits tend to infinity, we get:

$$F_{13} = \frac{1}{2.3} \left[\sqrt{v_2^2+z^2} - \sqrt{v_1^2+z^2} - \sqrt{(1.15-v_2)^2+z^2} + \sqrt{(1.15-v_1)^2+z^2} \right]$$

The expression for F_{12} follows by changing the integration limits (v_1, v_2) to $(v_2, v_1+1.15)$. The computation of v_2 is discussed on the following page.



To determine the quantity v_2 for the form factor calculation, we must compute the length a_3 as shown in the sketch above. γ is the opening angle of the blinds, α is thesolar profile angle. After applying some trigonometry, we obtain:

$$a_3 = 1.15 - \frac{1}{\cos\gamma\tan\alpha + \sin\gamma}$$

and $v_2 = \sin\gamma + a_3$

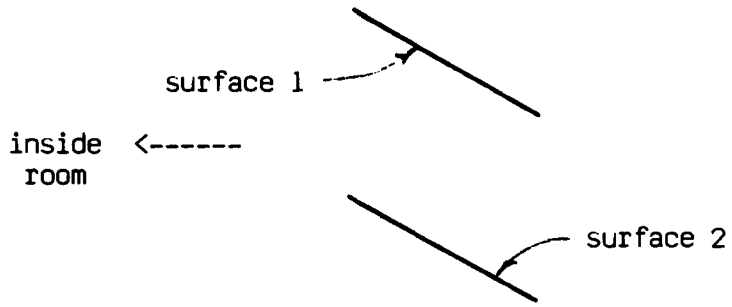
Finally, we must compute E_2. Note that no sunlight reaches either surface 1 or 3; hence $E_1 = E_3 = 0$. To compute E_2 we let B be the vertical illuminance on the window from direct sunlight. Assigning unit area to the window, this means that B lumens fall on the window. The illuminance E_2 is then B divided by the area of blinds exposed to sunlight, or

$$E_2 = \frac{B}{1.15 - a_3} = B(\cos\gamma\tan\alpha + \sin\gamma)$$

The average final exitance on the topside of the blinds is

$$L_{topside} = (L_2(1.15-a_3) + L_3a_3) / 1.15$$

F. Exitance on Blinds due to Sky or Ground



Cross-section view of 2 adjacent blinds vanes

We seek to determine the equilibrium exitance on the side of the blinds visible from within the room. We accomplish this with a 2-surface flux-transfer analysis: surface 1 is the underside, surface 2 is the topside of two adjacent vanes. The matrix form of the flux transfer equations is:

$$\begin{bmatrix} -1 & \rho F_{12} \\ \rho F_{12} & -1 \end{bmatrix} \begin{bmatrix} L_1 \\ L_2 \end{bmatrix} = \begin{bmatrix} -\rho E_1 \\ -\rho E_2 \end{bmatrix}$$

where ρ = blinds reflectance

F_{12} = form factor from surface 1 to surface 2 (in this case we have $F_{12} = F_{21}$)

L_i = final (equilibrium) exitance on surface i

E_i = initial illuminance on surface i

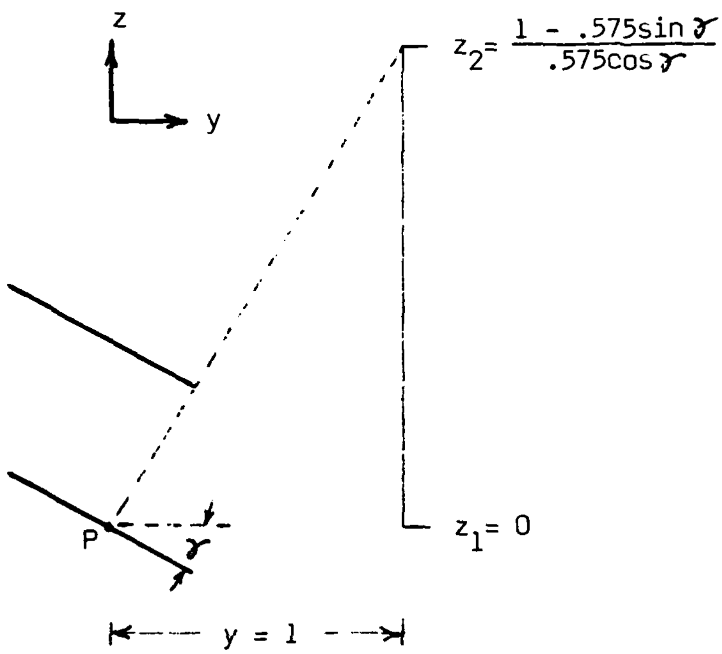
We may solve for L_1 and L_2 using Cramer's Rule:

$$L_1 = \rho \left[\frac{E_1 + \rho E_2 F12}{1 - \rho^2 F_{12}^2} \right] \qquad L_2 = \rho \left[\frac{E_2 + \rho E_1 F_{12}}{1 - \rho^2 F_{12}^2} \right]$$

The form factor F_{12} is obtained from the expression for F_{13} in Appendix E -- setting $v_2 = v_1 + 1.15 = \sin\gamma + 1.15$ in that expression, we get

$$F_{12} = \frac{1}{2.3} \left\{ \sqrt{2.3225 - 2.3 \sin\gamma} + \sqrt{2.3225 + 2.3 \sin\gamma} - 2 \right\}$$

F.1 Initial Illuminance on Top of Blinds due to the Sky



To compute illuminance E_2 at point p due to the sky, we treat the sky as an infinite x-z plane at distance y = 1 from p. The plane's exitance L is the same as the uniform sky brightness. The limits of integration are $(-\infty, \infty)$ in the x-direction, and $(0, z_2)$ in the z-direction. Assign p the (x,y,z) coordinate location (0,0,0); the illuminance at p from a point candlepower source at (x,1,z) on the infinite plane is

$$E = \frac{L}{\pi}\,\frac{1}{r}\,\frac{\sin\gamma + z\cos\gamma}{r}\,\frac{1}{r^2} \qquad \text{where } r = \sqrt{x^2 + 1 + z^2}$$

Hence the illuminance E_2 from the entire infinite plane is

$$E_2 = \frac{L}{\pi}\int_{-\infty}^{\infty}\int_{0}^{z_2}\frac{\sin\gamma + z\cos\gamma}{r^4}\,dx\,dz$$

$$= \frac{L\sin\gamma}{\pi}\int_{-\infty}^{\infty}\int_{0}^{z_2}\frac{dx\,dz}{(x^2+1+z^2)} + \frac{L\cos\gamma}{\pi}\int_{0}^{\infty}\int_{0}^{z_2}\frac{z\,dx\,dz}{(x^2+1+z^2)}$$

These two double integrals are special cases of those integrals leading to the configuration factors; <u>i.e.</u>,

$$\frac{L \sin\gamma}{\pi}\int_{-\infty}^{\infty}\int_{0}^{z_2}\frac{dx\ dz}{(x^2+z^2+1)} = \frac{L \sin\gamma}{2\pi}\left\{\frac{x}{\sqrt{x^2+1}}\tan^{-1}\frac{z}{\sqrt{x^2+1}} + \frac{z}{\sqrt{z^2+1}}\tan^{-1}\frac{x}{\sqrt{z^2+1}}\right\}\Bigg]_{-\infty}^{\infty}\Bigg]_{0}^{z_2}$$

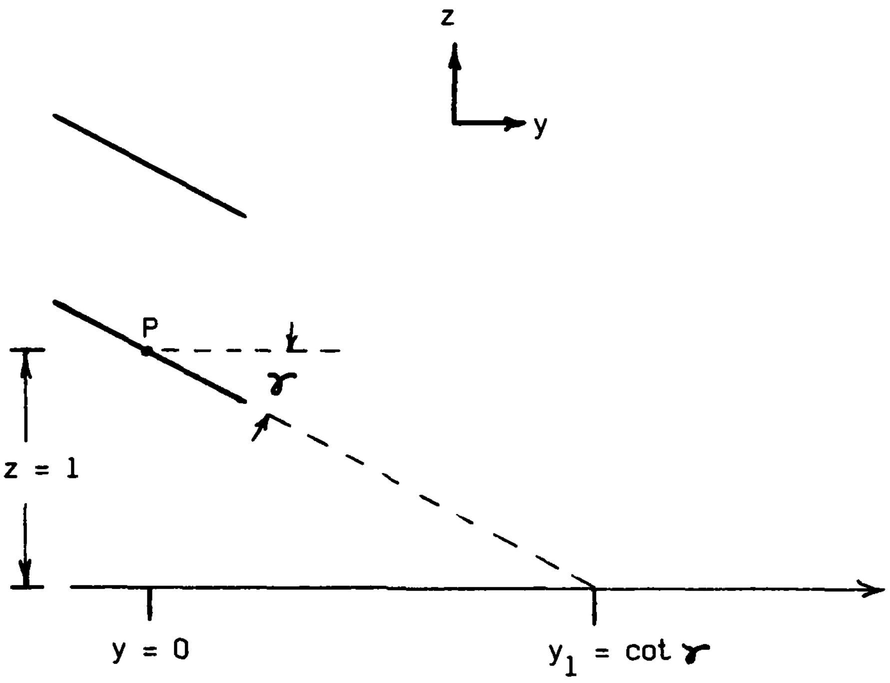
$$\frac{L \cos}{\pi}\int_{-\infty}^{\infty}\int_{0}^{z_2}\frac{z\ dx\ dz}{(x^2+z^2+1)} = \frac{L \cos\gamma}{2\pi}\left\{\frac{-1}{\sqrt{z^2+1}}\tan^{-1}\frac{x}{\sqrt{z^2+1}}\right\}\Bigg]_{-\infty}^{\infty}\Bigg]_{0}^{z_2}$$

and

$$E_2 = \frac{L \sin\gamma}{2\pi}\left[\frac{\pi\ z_2}{\sqrt{z_2^2+1}}\right] + \frac{L \cos\gamma}{2\pi}\left[\pi\left(1 - \frac{1}{\sqrt{z_2^2+1}}\right)\right]$$

where $z_2 = \dfrac{(1 - .575 \sin\gamma)}{.575 \cos\gamma}$

F.2 Initial Illuminance on Top of Blinds due to the Ground



Here the ground is an infinite x-y plane of uniform exitance L. For convenience we assign the infinite plane a distance $z = 1$ from the target point p. Proceeding in similar fashion to the previous section, we obtain

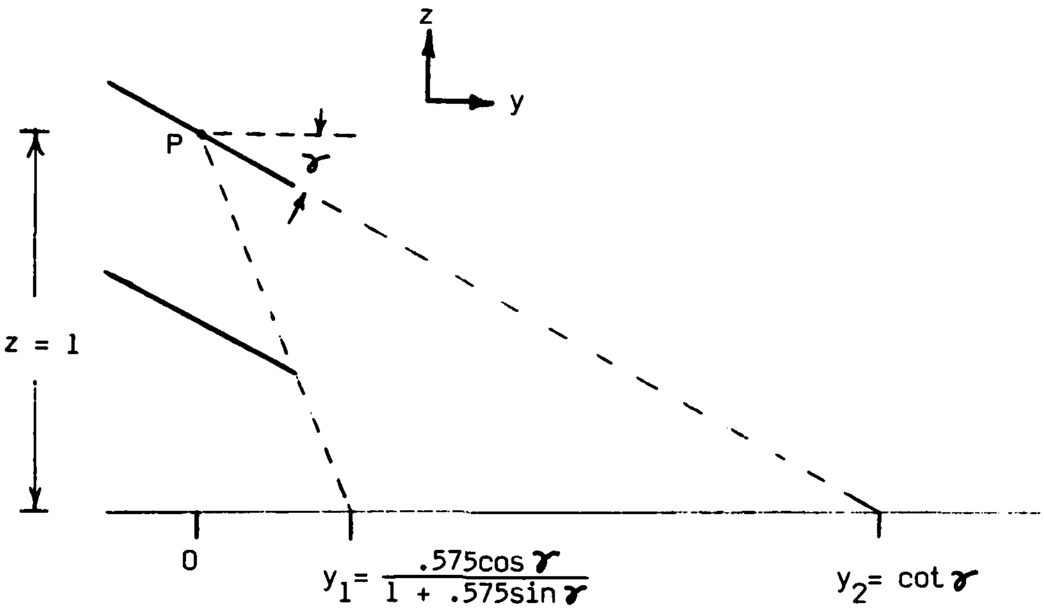
$$E_2 = \frac{L}{\pi}\int_{-\infty}^{\infty}\int_{y_1}^{\infty}\frac{1}{r}\,\frac{1}{r^2}\,\frac{y\sin\gamma - \cos\gamma}{r}\,dx\,dy$$

$$= \frac{L\sin\gamma}{\pi}\int_{-\infty}^{\infty}\int_{y_1}^{\infty}\frac{y\,dx\,dy}{(x^2+y^2+1)^2} - \frac{L\cos\gamma}{\pi}\int_{-\infty}^{\infty}\int_{y_1}^{\infty}\frac{dx\,dy}{(x^2+y^2+1)^2}$$

$$= \frac{L}{2}\left\{\frac{\sin\gamma}{\sqrt{y_1^2+1}} - \cos\gamma\left(1 - \frac{y_1}{\sqrt{y_1^2+1}}\right)\right\}$$

where $y_1 = \cot\gamma$

F.3 Initial Illuminance on Underside of Blinds due to the Ground



Again we treat the ground as an infinite x-y plane of uniform exitance L and at *distance* $z = 1$ from the target point p. We have

$$E_2 = \frac{L}{\pi}\int_{-\infty}^{\infty}\int_{y_1}^{y_2}\frac{1}{r}\,\frac{1}{r^2}\,\frac{\cos\gamma - y\sin\gamma}{r}\,dx\,dy$$

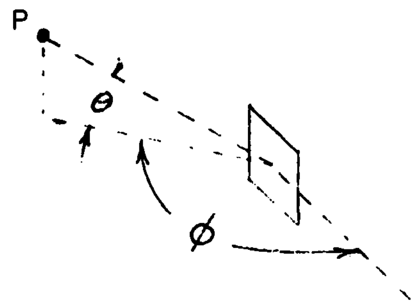
$$= \frac{L\cos\gamma}{\pi}\int_{-\infty}^{\infty}\int_{y_1}^{y_2}\frac{dx\,dy}{(x^2+y^2+1)^2} - \frac{L\sin\gamma}{\pi}\int_{-\infty}^{\infty}\int_{y_1}^{y_2}\frac{y\,dx\,dy}{(x^2+y^2+1)^2}$$

$$= \frac{L}{2}\left[\cos\gamma\left(\frac{y_2}{\sqrt{y_2^2+1}} - \frac{y_1}{\sqrt{y_1^2+1}}\right) - \sin\gamma\left(\frac{1}{\sqrt{y_1^2+1}} - \frac{1}{\sqrt{y_2^2+1}}\right)\right]$$

where $y_1 = \frac{.575\cos\gamma}{1 + .575\sin\gamma}$

$y_2 = \cot\gamma$

G. Zenith and Ground Brightness to Produce 1000 fc Vertical Illuminance



The calculations which involve the sky distributions require knowledge of the zenith luminance L_z; calculations involving the ground require knowledge of the ground exitance L_g. The sketch above illustrates the coordinate system used to arrive at L_z and L_g. Ø is the azimuth angle, θ is the elevation angle of the point p in the sky. Either the sky or ground may be treated as a quarter-sphere of unit radius. Therefore the vertical illuminance E is

$$E = \int_0^{\pi}\int_0^{\frac{\pi}{2}} \frac{L(\theta)}{\pi} \cos^2\theta \sin\phi \, d\phi \, d\theta$$

where L(θ) is the brightness of the sky at angle θ above the horizon. Using a 32-interval Simpson approximation for each different sky distribution, the following values of L_z were obtained:

Vertical/Horizontal Illuminance	L_z (fL)
0.75	3373.1
1.00	2000
1.25	1170.9
1.50	839.6
1.75	643.55

The ground may be treated in exactly the same way as the uniform sky, yielding

$$L_g = 2000 \text{ fL}$$

```
C-----------------------------------------------------------------
C GENERATE DAYLIGHT COEFFICIENT OF UTILIZATION TABLES
C
C            --- PROGRAM VARIABLES,ARRAYS ---
C A      - SCRATCH MATRIX FOR FLUX TRANSFER CALCULATIONS
C BFL    - FINAL EXITANCE ON UNDERSIDE OF BLINDS
C DIRECT(I,J) - DIRECT ILLUMINANCE ON TARGET PT I FROM SKY J
C E(I,J)      - CONFIGURATION FACTOR FROM ZONE I TO TARGET PT J
C E1GR        - ILLUMINANCE ON UNDERSIDE OF BLINDS FROM GROUND
C E1SKY(I)    - ILLUMINANCE ON UNDERSIDE OF BLINDS FROM SKY I
C E1SUN(I)    - ILLUMINANCE ON UNDERSIDE OF BLINDS FROM PROFILE I
C E2GR
C E2SKY       -    SAME AS E1, ONLY FOR TOPSIDE OF BLINDS
C E2SUN
C F           - AUXILIARY TABLE FOR CONFIGURATION FACTOR CALX
C FF(I)       - FORM FACTORS BETWEEN BLINDS FOR BLINDS SETTING I
C FTM         - MATRIX OF COEFFICIENTS FOR FLUX TRANSFER SOLUTION
C F12,F13,F21,F31 - FORM FACTORS AMONG BLINDS FOR SUNLIGHT CALX
C IBTYPE      -  1 = HORIZONTAL BLINDS,   2 = VERTICAL BLINDS
C LENGTH      - ROOM DEPTHS
C LOWER(I)    - ILLUMINANCE ON ZONE I FROM GROUND
C LZ(I)       - ZENITH LUMINANCE (FOR SKY I) TO GIVE 1000 FC VERTICAL
C NDIV        - ROOM DISCRETIZATION PARAMETERS
C OFILE       - OUTPUT FILE NAME
C PTRA(I)     - POINTS TO 1ST ELEMENT IN ARRAYS (E, UPPER, ETC.)
C                 FOR ROOM SURFACE I
C PTRZ(I)     - POINTS TO LAST ELEMENT FOR ROOM SURFACE I
C PVISL(I)    - FRACTION OF GROUND VISIBLE THRU BLINDS FROM ZONE I
C PVISU(I)    - FRACTION OF SKY VISIBLE THRU BLINDS FROM ZONE I
C PVISUN(I)   - FRACTION OF BLINDS UNDERSIDE NOT VISIBLE FROM ZONE I
C PVISTO(I)   - FRACTION OF BLINDS TOPSIDE NOT VISIBLE FROM ZONE I
C RAT         - RATIO OF ILLUMINANCE (AT CENTER OF ROOM) FROM INFINITE-
C                 WIDE WINDOW : 80'-WIDE WINDOW
C RHO         - ROOM SURFACE REFLECTANCES
C RHOB        - BLINDS REFLECTANCES
C ROOMD       - ROOM DIMENSIONS
C CU(I,J,K,L) - CU VALUE FOR TARGET PT I, WINDOW WIDTH J, ROOM
C                DEPTH K, CONFIGURATION L
C TEMP(I)     - TEMPORARILY SAVES CU VALUE AT TARGET PT I
C TPVIS(I)    - FRACTION OF SKY VISIBLE THRU BLINDS FROM TARGET PT I
C TPVIST(I)   - FRACTION OF BLINDS TOPSIDE NOT VISIBLE FROM TARGET PT I
C TPVISU(I)   - FRACTION OF BLINDS UNDERSIDE NOT VISIBLE FROM TARG PT I
C UNITL(I)    - CONFIGURATION FACTOR FROM GROUND TO ZONE I
C UNITU(I)    - CONFIGURATION FACTOR FROM SKY TO ZONE I
C UNITTP(I)   - CONFIGURATION FACTOR FROM SKY TO TARGET PT I
C UPPER(I,J)  - ILLUMINANCE ON ZONE I FROM SKY J
C WIDTH       - ROOM (=WINDOW) WIDTHS
C XTP,YTP     - (X,Y) COORDS. OF OF TARGET POINT
C ZEROS       - 150 ZEROES
C
```

```
      PROGRAM DAYCU2
      REAL ROOMD(3),F(11,11),E(150,5),UPPER(150,7),LOWER(150)
     & ,DIRECT(5,7),FF(6),FTM(6,6),A(6,6),RHO(6),RHOB(5)
     & ,PVISL(150),PVISU(150),TPVIS(5),E1SKY(7),E2SKY(7),E1SUN(7)
     & ,E2SUN(7),TEMP(5),UNITU(150),UNITL(150),UNITTP(5)
     & ,PVISUN(150),PVISTO(150),TPVIST(5),TPVISU(5)
     & ,CU(5,8,7,56),LENGTH(7),WIDTH(8),LZ(7),ZEROS(150)
     & ,F12(6),F13(6),F21(6),F31(6)
      INTEGER PTRA(6),PTRZ(6),NDIV(3),SKYDIS(56)
     & ,DEBUG
      CHARACTER OFILE*16,PAGE*20,DESC(2)*80
      INCLUDE 'CSIMP.NAV'
C
      DATA WIDTH/5.,10.,20.,30.,40.,60.,80.,10000./
     & ,RHO/.5,1.,.5,.5,.3,.7/, ZEROS/150*0./
     & ,LENGTH/10.,20.,30.,40.,60.,80.,100./
     & ,FF/.4556,.4445,.4114,.3572,.2835,.1953/
     & ,RHOB/0.,.3,.5,.7,.999/
     & ,DEBUG/1/, LZ/3373.1,2000.,1170.9,839.6,643.55,3245.3,1131./
     & ,SKYDIS/56*0/
C
      OPEN(UNIT=1,FILE='SYS$INPUT',STATUS='UNKNOWN')
      WRITE(1,1001)
 1001 FORMAT(' FILE NAME FOR OUTPUT?')
      READ(1,1002) OFILE
 1002 FORMAT(A)
      OPEN(UNIT=2,FILE=OFILE,STATUS='UNKNOWN')
C
C OUTERMOST LOOP IS ON ROOM DIMENSIONS
C
      ROOMD(3) = 10.
      WRITE(1,1003)
 1003 FORMAT(' -ENTER WIDTH RANGE, LENGTH RANGE ')
      READ(1,*) NW1,NW2,NL1,NL2
      WRITE(1,1004)
 1004 FORMAT(' -WHAT DISTRIBUTIONS ?')
      READ(1,*) (SKYDIS(I),I=1,8)
      WRITE(1,1005)
 1005 FORMAT(' -ENTER 0 OR 1 FOR ANGLE OF INCIDENCE LOSS:')
      READ(1,*) ITAU
      WRITE(1,1006)
 1006 FORMAT(' -UPPER, LOWER BLINDS ANGLE SETTINGS?')
      READ(1,*) IBANG1,IBANG2
      WRITE(1,1007)
 1007 FORMAT(' -WHAT RANGE OF BLINDS TYPES?')
      READ(1,*) IBTYP1,IBTYP2
      DO 200 IWID=NW1,NW2
      ROOMD(1) = AMIN1(WIDTH(IWID),80.)
      DO 200 ILEN=NL1,NL2
      ROOMD(2) = LENGTH(ILEN)
```

```
C
C RAT <-- RATIO OF INFINITE WINDOW ILLUMINANCE TO 80' WIDE
C          WINDOW ILLUMINANCE AT CENTER OF ROOM
C
      RAT = 1.
      IF(IWID.EQ.8) RAT = RATIO(.5*ROOMD(2))
C
C COMPUTE DISCRETIZATION PARAMETERS
C
      ZSIZE = 0.2 * AMAX1(ROOMD(1),ROOMD(2),ROOMD(3))
      DO 21 I=1,3
   21 NDIV(I) = 1 + .999 * ROOMD(I) / ZSIZE
C
C COMPUTE POINTERS TO ZONE ARRAY
C
      PTRA(1) = 1
      PTRZ(1) = NDIV(2) * NDIV(3)
      PTRA(3) = 1 + PTRZ(1)
      PTRZ(3) = PTRA(3) + NDIV(2)*NDIV(3) - 1
      PTRA(4) = 1 + PTRZ(3)
      PTRZ(4) = PTRA(4) + NDIV(1)*NDIV(3) - 1
      PTRA(5) = PTRZ(4) + 1
      PTRZ(5) = PTRA(5) + NDIV(1)*NDIV(2) - 1
      PTRA(6) = PTRZ(5) + 1
      PTRZ(6) = PTRA(6) + NDIV(1)*NDIV(2) - 1
C
C LOOP THRU ZONES AND COMPUTE CONTRIBUTION OF EACH TO THE 5 TARGET PTS
C
      XTP = .5 * ROOMD(1)
      DO 42 IT=1,5
      YTP = (1.1 - .2*IT) * ROOMD(2)
C
C CEILING ZONES
C
      ZSQ = ROOMD(3) * ROOMD(3)
      DO 24 J=1,NDIV(1)+1
      X = (J-1.) * ROOMD(1) / NDIV(1)  - XTP
      SQX = SQRT(X*X + ZSQ)
      DO 23 I=1,NDIV(2)+1
      Y = (I-1)*ROOMD(2) / NDIV(2)  - YTP
      SQY = SQRT(Y*Y + ZSQ)
      F(I,J) = (X * ATAN(Y/SQX) / SQX  + Y* ATAN(X/SQY) / SQY  / 6.2832
   23 CONTINUE
   24 CONTINUE
C
C COMPUTE CONTRIBUTION FROM EACH ZONE
C
      L = -1
      DO 27 J=1,NDIV(1)
      DO 26 I=1,NDIV(2)
```

```
      YI = YI1
      YI1 = YI + ROOMD(2)/NDIV(2)
      L = L + 1
      E(L+PTRA(5),IT) = 0.
      E(L+PTRA(6),IT) = F(I,J) + F(I+1,J+1) - F(I,J+1) -F(I+1,J)
   26 CONTINUE
   27 CONTINUE
C
C NOW DO SOUTH WALL
C
      DO 30 I=1,NDIV(3) + 1
      SQZ = SQRT(YTP*YTP + ((I-1)*ROOMD(3)/NDIV(3))**2)
      DO 29 J=1,NDIV(1) + 1
      F(I,J) = -YTP * ATAN(((J-1)*ROOMD(1)/NDIV(1)-XTP)/SQZ) /
     &  (SQZ * 6.2832)
   29 CONTINUE
   30 CONTINUE
C
C GET CONTRIBUTION FROM ZONES
C
      L = PTRA(4) - 1
      DO 33 J=1,NDIV(1)
      DO 32 I=1,NDIV(3)
      L = L + 1
      E(L,IT) = F(I,J) + F(I+1,J+1) - F(I,J+1) - F(I+1,J)
   32 CONTINUE
   33 CONTINUE
C
C FINALLY, DO EAST AND WEST WALLS TOGETHER
C
      DO 36 I=1,NDIV(3)+1
      SQZ = SQRT(XTP*XTP + ((I-1)*ROOMD(3)/NDIV(3))**2)
      DO 35 J=1,NDIV(2)+1
      F(I,J) = -XTP * ATAN(((J-1)*ROOMD(2)/NDIV(2) - YTP) / SQZ)
     &  / (SQZ * 6.2832)
   35 CONTINUE
   36 CONTINUE
C
C CONTRIBUTION FROM ZONES
C
      L = -1
      DO 39 J=1,NDIV(2)
      DO 38 I=1,NDIV(3)
      L = L + 1
      E(L+PTRA(1),IT) = F(I,J) + F(I+1,J+1) - F(I,J+1) - F(I+1,J)
      E(L+PTRA(3),IT) = E(L+PTRA(1),IT)
   38 CONTINUE
   39 CONTINUE
   42 CONTINUE
C
```

```
C COMPUTE ILLUMINANCE TO ALL POINTS IN ROOM
C UNITL,UNITU,UNITTP <-- UNIFORM SKY, WITHOUT INCIDENCE ANGLE LOSS
C   FIRST, FLOOR AND CEILING
C
      L = -1
      DO 45 J=1,NDIV(1)
      XTP = (J-.5) * ROOMD(1) / NDIV(1)
      DO 44 I=1,NDIV(2)
      YTP = (I-.5) * ROOMD(2) / NDIV(2)
      L = L + 1
      X1 = -AMIN1(XTP,40.*(ROOMD(2)-YTP))
      X2 = AMIN1(ROOMD(1)-XTP,40.*(ROOMD(2)-YTP))
      DO 43 ISKY=1,7
      IF(SKYDIS(ISKY).NE.1) GOTO 43
      UPPER(L+PTRA(5),ISKY) = RAT * RILLUM(X1,X2,0.,ROOMD(3)
     & ,ROOMD(2)-YTP,5,ISKY,ITAU,TAU) * LZ(ISKY)
      UPPER(L+PTRA(6),ISKY) = 0.
      IF(ISKY.NE.2) GOTO 43
      UNITU(L+PTRA(5)) = UPPER(L+PTRA(5),2) / (TAU * LZ(2))
      UNITU(L+PTRA(6)) = 0.

   43 CONTINUE
      LOWER(L+PTRA(5)) = 0.
      LOWER(L+PTRA(6)) = UPPER(L+PTRA(5),2)
      UNITL(L+PTRA(5)) = 0.
      UNITL(L+PTRA(6)) = UNITU(L+PTRA(5))
   44 CONTINUE
   45 CONTINUE
C
C NEXT WEST WALL (AND EAST WALL)
C
      L = -1
      DO 48 J=1,NDIV(2)
      YTP = (J-.5) * ROOMD(2) / NDIV(2)
      DO 47 I=1,NDIV(3)
      ZTP = (I-.5) * ROOMD(3) / NDIV(3)
      L = L + 1
      X2 = AMIN1(ROOMD(1),40.*(ROOMD(2)-YTP))
      DO 46 ISKY=1,7
      IF(SKYDIS(ISKY).NE.1) GOTO 46
      UPPER(L+PTRA(1),ISKY) = RAT * RILLUM(0.,X2,0.,ROOMD(3)-ZTP
     & ,ROOMD(2)-YTP,1,ISKY,ITAU,TAU) * LZ(ISKY)
      UPPER(L+PTRA(3),ISKY) = UPPER(L+PTRA(1),ISKY)
      IF(ISKY.NE.2) GOTO 46
      UNITU(L+PTRA(1)) = UPPER(L+PTRA(1),2) / (TAU * LZ(2))
      UNITU(L+PTRA(3)) = UNITU(L+PTRA(1))
   46 CONTINUE
      LOWER(L+PTRA(1)) = RAT * RILLUM(0.,X2,0.,ZTP,ROOMD(2)-YTP
     &  ,1,2,ITAU,TAU) * LZ(2)
      LOWER(L+PTRA(3)) = LOWER(L+PTRA(1))
```

```
      UNITL(L+PTRA(1)) = LOWER(L+PTRA(1)) / (TAU * LZ(2))
      UNITL(L+PTRA(3)) = UNITL(L+PTRA(1))
   47 CONTINUE
   48 CONTINUE
C
C FINALLY, THE SOUTH WALL
C
      L = -1
      DO 51 J=1,NDIV(1)
      XTP = (J-.5) * ROOMD(1) / NDIV(1)
      DO 50 I=1,NDIV(3)
      ZTP = (I-.5) * ROOMD(3) / NDIV(3)
      L = L + 1
      X1 = -AMIN1(XTP,40.*ROOMD(2))
      X2 = AMIN1(ROOMD(1)-XTP,40.*ROOMD(2))
      DO 49 ISKY=1,7
      IF(SKYDIS(ISKY).EQ.1) UPPER(L+PTRA(4),ISKY) = RAT *
     & RILLUM(X1,X2,0.,ROOMD(3)-ZTP,ROOMD(2),4,ISKY,ITAU,TAU)*LZ(ISKY)
      IF(ISKY.EQ.2) UNITU(L+PTRA(4))=UPPER(L+PTRA(4),2) /(TAU*LZ(2))
   49 CONTINUE
      LOWER(L+PTRA(4)) = RAT * RILLUM(X1,X2,0.,ZTP,ROOMD(2),4,2,ITAU
     &   ,TAU) * LZ(2)
      UNITL(L+PTRA(4)) = LOWER(L+PTRA(4)) / (TAU * LZ(2))
   50 CONTINUE
   51 CONTINUE
C
C COMPUTE DIRECT ILLUMINANCE FROM WINDOW TO TARGET PTS
C
      XTP = .5 * ROOMD(1)
      DO 55 I=1,5
      YTP = (.2*I - .1) * ROOMD(2)
      X2 = AMIN1(XTP,40.)
      DO 54 ISKY=1,7
      IF(SKYDIS(ISKY).EQ.1) DIRECT(I,ISKY) = RAT * RILLUM(-X2,X2
     & ,0.,ROOMD(3),YTP,5,ISKY,ITAU,TAU) * LZ(ISKY)
      IF(ISKY.EQ.2) UNITTP(I) = DIRECT(I,2) / (TAU * LZ(2))
   54 CONTINUE
   55 CONTINUE
      WRITE(DEBUG,2013) ROOMD(1),ROOMD(2)
 2013 FORMAT(' ROOM: ',F6.0,'  X ',F6.0)
C
C     WRITE(DEBUG,2006) ((DIRECT(I,J),J=1,7),I=1,5)
C2006 FORMAT(/' DIRECT TO TARGET PTS:'/(1X,7F8.3))
C
C COMPUTE THE FLUX TRANSFER MATRIX, LOOP THRU BLINDS TYPES
C
      CALL FTMATR(ROOMD,FTM)
      DO 57 I=1,6
      IF(I.EQ.2) GOTO 57
      DO 56 J=PTRA(I),PTRZ(I)
```

```
      PVISU(J) = 1.
      PVISL(J) = 1.
      IF(I.EQ.5) PVISL(J) = 0.
      IF(I.EQ.6) PVISU(J) = 0.
   56 CONTINUE
   57 CONTINUE
C
      DO 58 I=1,5
   58 TPVIS(I) = 1.
C
C READ THE LABELS INTO SPACE USED FOR SIMPSON INTEGRATION
C
      OPEN(UNIT=3,FILE='LABELS.NAV',STATUS='OLD')
      DO 62 I=1,56
      READ(3,1010) ((RDESC(K,J,I),K=1,20),J=1,2)
 1010 FORMAT(4X,20A4)
   62 CONTINUE
      CLOSE(UNIT=3)
C
C COMPUTE ENTRIES FOR SKY AND GROUND TABLES THRU UNOBSTRUCTED WINDOWS
C
      DO 85 ISKY=1,7
      IF(SKYDIS(ISKY).NE.1) GOTO 85
      CALL COMPE(FTM,A,PVISU,PVISL,TPVIS,-15.,UPPER(1,ISKY),ZEROS
     & ,DIRECT(1,ISKY),0.,0.,RHO,CU(1,IWID,ILEN,ISKY)
     & ,PTRA,PTRZ,UNITU,UNITL,UNITTP,E)
   85 CONTINUE
C
C NOW THE GROUND TABLE
C
      CALL COMPE(FTM,A,PVISU,PVISL,TPVIS,-1.,ZEROS,LOWER,ZEROS,0.,0.
     & ,RHO,CU(1,IWID,ILEN,8),PTRA,PTRZ,UNITU,UNITL,UNITTP,E)
C
C LOOP ON BLINDS TYPE, THEN BLINDS ANGLE
C
      DO 100 IBTYPE=IBTYP1,IBTYP2
      DO 98 IANG=IBANG1,IBANG2
      ANG = 15. * (IANG-1)
      WRITE(DEBUG,2007) ANG
 2007 FORMAT(' BLINDS ANGLE ',F5.0)
C
C COMPUTE % VISIBLE FROM EACH POINT IN ROOM
C
      CALL SKYVIS(ROOMD,NDIV,PTRA,PTRZ,PVISL,PVISU,TPVIS,IBTYPE
     & ,ANG,PVISUN,PVISTO,TPVISU,TPVIST)
C
C GET THRU COMPONENT - SKY
C
      L = 8 + 6*(IBTYPE-1) + IANG
      CALL COMPE(FTM,A,PVISU,PVISL,TPVIS,ANG,UPPER(1,2),ZEROS
```

```
     & ,DIRECT(1,2),0.,.5,RHO,CU(1,IWID,ILEN,L),PTRA,PTRZ
     & ,UNITU,UNITL,UNITTP,E)
      SKYDIS(L) = 1
C
C THRU COMPONENT - GROUND
C
      L = 20 + 6*(IBTYPE-1) + IANG
      CALL COMPE(FTM,A,PVISU,PVISL,TPVIS,ANG,ZEROS,LOWER,ZEROS,0.
     & ,.5,RHO,CU(1,IWID,ILEN,L),PTRA,PTRZ,UNITU,UNITL,UNITTP,E)
      SKYDIS(L) = 1
C
C UNDERSIDE OF BLINDS
C
      L = 32 + 6*(IBTYPE-1) + IANG
      CALL COMPE(FTM,A,PVISUN,PVISUN,TPVISU,ANG,ZEROS,ZEROS,ZEROS
     & ,1000.,.5,RHO,CU(1,IWID,ILEN,L),PTRA,PTRZ,UNITU,UNITL,UNITTP,E)
      SKYDIS(L) = 1
C
C TOPSIDE OF BLINDS
C
      L = 44 + 6*(IBTYPE-1) + IANG
      CALL COMPE(FTM,A,PVISTO,PVISTO,TPVIST,ANG,ZEROS,ZEROS,ZEROS
     & ,1000.,.5,RHO,CU(1,IWID,ILEN,L),PTRA,PTRZ,UNITU,UNITL,UNITTP,E)
      SKYDIS(L) = 1
  98  CONTINUE
 100  CONTINUE
 200  CONTINUE
C
      DO 210 I=1,56
      IF(SKYDIS(I).NE.1) GOTO 210
      PAGE = ' '
      WRITE(DESC(1),1008) (RDESC(J,1,I),J=1,20)
 1008 FORMAT(20A4)
      WRITE(DESC(2),1008) (RDESC(J,2,I),J=1,20)
      CALL BFORMT(2,CU(1,1,1,I),PAGE,DESC,2)
 210  CONTINUE
      STOP
      END
C-----------------------------------------------------------
C COMPUTE RATIO OF INFINITE-WIDTH WINDOW ILLUMINANCE TO
C  80'-WIDE WINDOW ILLUMINANCE
C Y - Y-DISTANCE TO WINDOW
C
      FUNCTION RATIO(Y)
      SQYZ = SQRT(Y*Y + 100.)
      E80 = (ATAN(40./Y) - (Y/SQYZ)*ATAN(40./SQYZ)) / 3.14159
      RATIO = (.5 * (1.- Y/SQYZ)) / E80
      RETURN
      END
C-------------------------------------------------------------
```

```
C THIS ROUTINE PRINTS OUT A 'BASIC FORMAT' DAYLIGHT CU TABLE
C  CU    - TABLE OF CU'S TO BE PRINTED
C  DESC - N LINES OF DESCRIPTION TO BE CENTERED AT TOP
C  PAGE - PAGE # TO BE PRINTED
C  LU    - OUTPUT DEVICE LOGICAL UNIT #
C
      SUBROUTINE BFORMT(LU,CU,PAGE,DESC,N)
      REAL CU(5,8,7)
      CHARACTER PAGE*20,DESC(N)*80,LINE*80,DH(7)*2,CH2*2
C
      DATA DH/' 1',' 2',' 3',' 4',' 6',' 8','10'/
C
      WRITE(LU,1001) PAGE
 1001 FORMAT('1'//37X,A//)
C
      DO 10 I=1,N
      CALL CENTER(DESC(I),LINE,80)
      WRITE(LU,1002) LINE(1:LASN8(LINE,80))
 1002 FORMAT(2X,A)
  10  CONTINUE
C
C TOP HEADER INFO
C
      WRITE(LU,1003)
 1003 FORMAT(/12X,59('-')
     & /12X,'| ROOM DEPTH /  |',41X,'|'
     & /12X,'| WINDOW HEIGHT |  WINDOW WIDTH / WINDOW HEIGHT '
     &     ,'    W / H |'
     & /12X,'|',15X,'|',41X,'|'
     & /12X,'|  D / H    % D |  .5    1    2    3    4    6'
     &    ,'    8   INF |'
     & /12X,59('-') )
C
C OUTER LOOP ON ROOM DEPTH / WINDOW HEIGHT RATIO
C
      DO 50 K=1,7
      DO 40 I=1,5
      CH2  = '  '
      IF(I.EQ.3) CH2 = DH(K)
      WRITE(LU,1004) CH2, 20*I-10, (NINT(CU(I,J,K)),J=1,8)
 1004 FORMAT(12X,'|   ',A2,6X,I3,' |',8I5.3,' |')
  40  CONTINUE
C
      WRITE(LU,1005)
 1005 FORMAT(12X,59('-'))
  50  CONTINUE
      RETURN
      END
C------------------------------------------------------------
C CENTER STRING 'A' IN STRING 'B'
```

```
C
      SUBROUTINE CENTER(A,B,N)
      CHARACTER A*80,B*80
C
      L = 0
   10 L = L + 1
      IF(A(L:L).EQ.' ' .AND. L.LT.N) GOTO 10
      M = LASNB(A,N)
      B = ' '
      I = (N - (M-L)) / 2
      B(I:I+M-L) = A(L:M)
      RETURN
      END
C-------------------------------------------------------------
C COMPUTE ILLUMINANCE AT EACH TARGET POINT
C  AA - ORIGINAL FLUX XFER MATRIX
C  A  - MODIFIED FLUX XFER MATRIX
C  PVISU - FRACTION OF UPPER WINDOW VISIBLE THRU BLINDS FROM ZONES
C  PVISL - FRACTION OF LOWER WINDOW
C  TPVIS - FRACTION OF WINDOW VISIBLE FROM TARGET PTS
C  GAMMA - BLINDS OPENING ANGLE (NEGATIVE --> NO BLINDS)
C  EUP   - INITIAL E ON ZONES FROM SKY
C  ELOW  - INITIAL E ON ZONES FROM GROUND
C  ETP   - INITIAL E ON TARGET PTS FROM SKY
C  BL    - EXITANCE OF BLINDS
C  RHOB  - REFLECTANCE OF BLINDS
C  B     - RIGHT-HAND SIDE VECTOR
C  RHO   - REFLECTANCE OF ROOM SURFACES
C  EANS  - ILLUMINANCE AT TARGET PTS (ANSWERS)
C  EUNU  - ILLUM. ON ZONES FROM UNIFORM UPPER WINDOW
C  EUNL  - ILLUM. ON ZONES FROM UNIFORM GROUND (UNIT EXITANCE)
C  ETPUN - ILLUM. ON TARGET PTS FROM UNIFORM WINDOW
C  ZONTP - E ON TARGET PTS FROM ROOM SURFACE ZONES
C
      SUBROUTINE COMPE(AA,A,PVISU,PVISL,TPVIS,GAMMA,EUP,ELOW
     & ,ETP,BL,RHOB,RHO,EANS,PTRA,PTRZ,EUNU,EUNL,ETPUN,ZONTP)
      REAL AA(6,6),A(6,6),PVISU(150),PVISL(150),TPVIS(5),EUP(150)
     & ,ELOW(150),ETP(5),B(6),RHO(6),E(150),EUNU(150),ETPUN(5)
     & ,EUNL(150)
     & ,RHS(6),EANS(5),FLUM(6),ZONTP(150,5)
      INTEGER PTRA(6),PTRZ(6)
     & ,DEBUG
      DATA DEBUG/1/
C
C COPY FLUX TRANSFER MATRIX, ADJUSTING ROW 2 FOR EFFECTIVE
C  REFLECTANCE OF WINDOW-BLINDS
C
      SING = SIN(GAMMA/57.29578)
C     RW = RHOB * SING
      RW = .5 * SING
```

```
      IF(GAMMA.LT.-0.01) RW = 0.
      RHO(2) = RW
      DO 12 J=1,6
      DO 11 I=1,6
   11 A(I,J) = AA(I,J)
      A(2,J) = AA(2,J) * RW
   12 CONTINUE
      A(2,2) = -1.
      RHS(2) = 0.
C
C COMPUTE AVG INITIAL E ON ROOM SURFACES
C
      DO 16 I=1,6
      IF(I.EQ.2) GOTO 16
      B(I) = 0.
      DO 14 J=PTRA(I),PTRZ(I)
      E(J) = EUP(J) * PVISU(J)  +  ELOW(J) * PVISL(J)
     &  + EUNU(J) * BL * (1.-PVISU(J))  + EUNL(J) * BL * (1.-PVISL(J))
      B(I) = B(I) + E(J)
   14 CONTINUE
      B(I) = B(I) / (PTRZ(I)-PTRA(I)+1)
      RHS(I) = -RHO(I) * B(I)
   16 CONTINUE
C
C SOLVE THE FLUX TRANSFER MATRIX, THEN ADJUST FINAL ZONE EXITANCES
C
      CALL GJORDN(A,RHS,FLUM,6)
      DO 20 I=1,6
      IF(I.EQ.2) GOTO 20
      DO 18 J=PTRA(I),PTRZ(I)
      E(J) = RHO(I) * (E(J) + FLUM(I)/RHO(I) -B(I))
   18 CONTINUE
   20 CONTINUE
C
C ADD THE ZONE CONTRIBUTIONS TO THE TARGET PT ILLUMINANCES
C
      DO 25 K=1,5
      EANS(K) = ETP(K)*TPVIS(K) + ETPUN(K)*(FLUM(2) +BL*(1.-TPVIS(K)))
      DO 23 J=PTRA(1),PTRZ(6)
   23 EANS(K) = EANS(K) + ZONTP(J,K) * E(J)
   25 CONTINUE
C
      RETURN
      END
C-----------------------------------------------------------------
C RETURN THE (COS THETA / (PI * D**2) ) FACTOR FOR FORMATION
C OF THE SIMPSON INTEGRAND
C  (X,Y,Z) - POINT ON NORTH WALL (=WINDOW WALL)
C     D     - DISTANCE TO (X,Y,Z)
C  ISURF   - SURFACE # (1=WEST WALL, ETC.)
```

```
C
      FUNCTION COSD2(X,Y,Z,D,ISURF)
C
      GOTO (10,20,10,20,50,50),ISURF
C
C WEST OR EAST WALL
C
   10 CONTINUE
      COSD2 = ABS(X) * Y / (D*D*D*D * 3.14159)
      RETURN
C
C SOUTH WALL
C
   20 CONTINUE
      COSD2 = Y * Y / (D*D*D*D * 3.14159)
      RETURN
C
C CEILING / FLOOR
C
   50 CONTINUE
      COSD2 = Z * Y / (D*D*D*D * 3.14159)
      RETURN
      END
C----------------------------------------------------------
C COMPUTE NORMAL ILLUMINANCE ON TOP OF HORIZ. BLINDS DUE
C TO THE GROUND
C
      FUNCTION ETG(L,SING,COSG)
      REAL L
      ETG = 0.
      IF(SING.LT.0.01) RETURN
      Y1 = COSG/SING
      SQY1 = SQRT(1.+ Y1*Y1)
      ETG = .5 * L * (SING/SQY1 - COSG*(1.-Y1/SQY1))
      RETURN
      END
C----------------------------------------------------------
C COMPUTE NORMAL ILLUMINANCE ON TOP OF HORIZ. BLINDS DUE
C TO THE UNIFORM SKY
C
      FUNCTION ETS(L,SING,COSG)
      REAL L
      Z = 10.**8.
      IF(COSG.GT.0.01) Z = (1.-.575*SING) / (.575*COSG)
      SQZ = SQRT(1.+ Z*Z)
      ETS = .5 * L * (SING*Z/SQZ + COSG*(1.-1./SQZ))
      RETURN
      END
C------------------------------------------------------------
C COMPUTE NORMAL ILLUMINANCE ON UNDERSIDE OF HORIZ. BLINDS
```

```
C DUE TO THE GROUND
C  SING,COSG - SINE,COSINE OF BLINDS TILT ANGLE
C  L  - EXITANCE OF GROUND
C
      FUNCTION EUG(L,SING,COSG)
      REAL L
      Y1 = .575 * COSG / (1.+ .575*SING)
      Y2 = 10.**8.
      IF(SING.GT.0.01) Y2 = COSG / SING
      SQY1 = SQRT(1. + Y1*Y1)
      SQY2 = SQRT(1. + Y2*Y2)
      EUG = 0.5 * L * ( COSG*(Y2/SQY2 - Y1/SQY1)
     *   - SING * (1./SQY1 - 1./SQY2))
      RETURN
      END
C-----------------------------------------------------------
C COMPUTE THE FLUX TRANSFER MATRIX
C
      SUBROUTINE FTMATR(ROOMD,A)
      REAL ROOMD(3),A(6,6),RHO(6)
      DATA RHO/.5,1.,.5,.5,.2,.8/
C
      A(1,2) = PERFF(ROOMD(1),ROOMD(3),ROOMD(2))
      A(1,5) = PERFF(ROOMD(1),ROOMD(2),ROOMD(3))
      A(1,3) = 1. - 2.* (A(1,2) + A(1,5))
      A(2,1) = (ROOMD(2) / ROOMD(1)) * A(1,2)
      A(2,5) = PERFF(ROOMD(2),ROOMD(1),ROOMD(3))
      A(2,4) = 1. - 2. * (A(2,1) + A(2,5))
      A(1,4) = A(1,2)
      A(1,6) = A(1,5)
      A(2,3) = A(2,1)
      A(2,6) = A(2,5)
      A(5,1) = (ROOMD(3)/ROOMD(1)) * A(1,5)
      A(5,2) = (ROOMD(3)/ROOMD(2)) * A(2,5)
      A(5,3) = A(5,1)
      A(5,4) = A(5,2)
      A(5,6) = 1. - 2. * (A(5,1) + A(5,2))
      DO 10 J=1,6
      A(3,J) = A(1,J)
      A(4,J) = A(2,J)
   10 A(6,J) = A(5,J)
      A(3,1) = A(1,3)
      A(4,2) = A(2,4)
      A(6,5) = A(5,6)
C
      DO 20 I=1,6
      DO 18 J=1,6
   18 A(I,J) = A(I,J) * RHO(I)
      A(I,I) = -1.
   20 CONTINUE
```

```
      RETURN
      END
C-----------------------------------------------------------
C FORM FACTOR FOR 2 PERPENDICULAR ADJACENT SURFACES
C  SOURCE SURFACE IN Y-Z PLANE, RECEIVING SURFACE IN X-Y PLANE
C
      FUNCTION PERFF(X,Y,Z)
      X2 = X * X
      Y2 = Y * Y
      Z2 = Z * Z
      TZ = .25 * (-Z2*LOG(Z2) + Z2)
      TX = .25 * (-X2*LOG(X2) + X2)
      TY = .25 * (-Y2*LOG(Y2) +Y2)
      TXZ = .25 * (-(X2+Z2)*LOG(X2+Z2) + (X2+Z2))
      TYZ = Y * Z * ATAN(Y/Z) + .5 * Y2 * LOG((Y2+Z2)/Y2)
     &    -.25 * (Y2+Z2)*LOG(Y2+Z2)  +  .25 * (Y2+Z2)
      TXY = Y * X * ATAN(Y/X) + .5 * Y2 * LOG((Y2+X2)/Y2)
     &    -.25 * (Y2+X2)*LOG(Y2+X2)  +  .25 * (Y2+X2)
      SQXZ = SQRT(X2+Z2)
      TXYZ = Y * SQXZ * ATAN(Y/SQXZ)  + .5 * Y2 *
     &   LOG((X2+Y2+Z2)/Y2)  - .25 * (X2+Y2+Z2) * LOG(X2+Y2+Z2)
     &   + .25 * (X2+Y2+Z2)
      PERFF = 2.*(TX + TY + TZ + TXYZ) - 2.*(TXZ+TYZ+TXY)
      PERFF = -PERFF / (Y*Z*6.2831853)
      RETURN
      END
C-----------------------------------------------------------
C SOLVE THE MATRIX EQUATION   AX = B
C   (A IS DIAGONALLY DOMINANT)
C
      SUBROUTINE GJORDN(A,B,X,N)
      REAL A(6,6),X(6),B(6)
C
      DO 10 I=1,N
   10 X(I) = B(I)
      DO 25 I=1,N
      R = 1. / A(I,I)
      DO 12 J=1,N
   12 A(I,J) = A(I,J) * R
      X(I) = X(I) * R
C
      DO 16 K=1,N
      IF(K.EQ.I) GOTO 16
      Q = A(K,I)
      DO 15 J=1,N
   15 A(K,J) = A(K,J) - Q*A(I,J)
      X(K) = X(K) - Q*X(I)
   16 CONTINUE
   25 CONTINUE
      RETURN
```

```
      END
C-----------------------------------------------------
C FIND LAST NON-BLANK IN STRING 'S'
C
      FUNCTION LASNB(S,N)
      CHARACTER S*80
C
      LASNB = N + 1
   10 LASNB = LASNB - 1
      IF(S(LASNB:LASNB).EQ.' ' .AND. LASNB.GT.1) GOTO 10
      RETURN
      END
C-------------------------------------------------------------
C COMPUTE ILLUMINANCE FROM THE WINDOW TO A POINT IN THE ROOM
C  (X1,X2) - X-LIMITS OF WINDOW
C  (Z1,Z2) - Z-LIMITS OF WINDOW
C  ISURF - SURFACE POINT LIES ON
C  ISKY  - (1-7) IDENTIFIES SKY BRIGHTNESS DISTRIBUTION
C  ITAU  - 0 = IGNORE LOSSES DUE TO ANGLE OF INCIDENCE
C          1 = ACCOUNT FOR SUCH LOSSES
C  ATAU   - TRANSMISSION LOSS DUE TO ANGLE OF INCIDENCE
C
      FUNCTION RILLUM(X1,X2,Z1,Z2,Y,ISURF,ISKY,ITAU,ATAU)
      INCLUDE 'CSIMP.NAV'
C
C PARTITION WINDOW FOR SIMPSON INTEGRATION
C
      ZSIZE = 0.2 * Y
      NX = 1 + MIN1(199.,.999*(X2-X1)/ZSIZE)
      NZ = 1 + MIN1(49.,.999*(Z2-Z1)/ZSIZE)
      NX = NX + MOD(NX,2)
      NZ = NZ + MOD(NZ,2)
C
C COMPUTE TABULATED VALUES FOR SIMPSON INTEGRATION
C
      ATAU = 0.
      TAU = 1.
      DO 15 I=1,NZ+1
      Z = (I-1) * (Z2-Z1) / NZ  + Z1
      DO 15 J=1,NX+1
      X = 'J-1) * (X2-X1) / NX  + X1
      D = SQRT(X*X + Y*Y + Z*Z)
      CTH = COSD2(X,Y,Z,D,ISURF)
      IF(ITAU.EQ.1) TAU = TLOSS(X,Y,Z,D)
      FS(I,J) = CTH * TAU * SKYBR(ISKY,X,Y,Z,D)
      ATAU = ATAU + TAU
   15 CONTINUE
      ATAU = ATAU / ((NX+1)*(NZ+1))
C
C PERFORM SIMPSON INTEGRATION
```

```
C
      RILLUM = SIMP2(X2-X1,Z2-Z1,NX,NZ)
      RETURN
      END
C------------------------------------------------------------
C EVALUATE A 2-DIMENSIONAL INTEGRAL BY SIMPSON'S RULE
C  DX - X-DISTANCE SPANNED BY COLUMNS
C  DY - Y-DISTANCE SPANNED BY ROWS
C  NX - # X INTERVALS (EVEN)
C  NY - # Y INTERVALS (EVEN)
C  F  - FUNCTION VALUES
C
      FUNCTION SIMP2(DX,DY,NX,NY)
      REAL R(51)
      INCLUDE 'CSIMP.NAV'
C
C INTEGRATE EACH ROW
C
      DO 25 I=1,NY+1
      R(I) = FS(I,1) + FS(I,NX+1)
C
      DO 23 J=2,NX,2
  23  R(I) = R(I) +  4.* FS(I,J)
C
      DO 21 J=3,NX-1,2
  21  R(I) = R(I) +  2.* FS(I,J)
  25  CONTINUE
C
C NOW INTEGRATE THE INTEGRATED ROWS
C
      SIMP2 = R(1) + R(NY+1)
      DO 35 I=2,NY,2
  35  SIMP2 = SIMP2 + 4.* R(I)
C
      DO 38 I=3,NY-1,2
  38  SIMP2 = SIMP2 + 2.* R(I)
      SIMP2 = SIMP2 * DX * DY / (9.*NX*NY)
      RETURN
      END
C------------------------------------------------------------
C RETURN SKY BRIGHTNESS EVIDENT AT POINT (X,Y,Z) ON WINDOW
C WHICH IS IN X-Z PLANE
C  D  - DISTANCE TO (X,Y,Z)
C  I  - SKY DISTRIBUTION (1 --> V/H = 0.75, ETC.)
C ZENITH LUMINANCE IS ASSUMED = 1
C
      FUNCTION SKYBR(I,X,Y,Z,D)
      REAL C(5),DENOM(5)
C
      DATA C/0.,0.,-.6,-.26,-.13/, DENOM/0.,0.,.45119,.22895,.1219/
```

```
C
      GOTO (10,20,30,30,30,60,70),I
C
C V/H = 0.75 (OVERCAST SKY)
C
  10  CONTINUE
      SKYBR = 0.301
      IF(Z.GT.0.05) SKYBR = .301 + 1.273 * EXP(-.6*D/Z)
      RETURN
C
C V/H = 1.00 (UNIFORM SKY)
C
  20  CONTINUE
      SKYBR = 1.
      RETURN
C
C V/H = 1.25, 1.50, 1.75 (PARTLY CLOUDY TO CLEAR SKIES)
C
  30  CONTINUE
      TERM = 1.
      IF(Z.GT.0.05) TERM = 1. - EXP(C(I)*D/Z)
      SKYBR = TERM / DENOM(I)
      RETURN
C
C TRADITIONAL OVERCAST SKY --  L = (LZ/3) * (1 + 2 SIN H)
C
  60  CONTINUE
      SKYBR = (1. + 2.*Z/D) / 3.
      RETURN
C
C LATERALLY UNIFORM CLEAR SKY -- L = 3 LZ / (1 + 2 SIN H)
C
  70  CONTINUE
      SKYBR = 3./ (1. + 2.*Z/D)
      RETURN
      END
C-------------------------------------------------------------
C FOR A GIVEN BLINDS ANGLE SETTING, DETERMINE THE PROPORTION OF
C SKY VISIBLE AT EACH POINT IN THE ROOM
C
      SUBROUTINE SKYVIS(ROOMD,NDIV,PTRA,PTRZ,PVISL,PVISU,TPVIS
     & ,BLTYPE,GAMMA,PVISUN,PVISTO,TPVISU,TPVIST)
      REAL ROOMD(3),PVISU(150),PVISL(150),TPVIS(5)
     & ,PVISUN(150),PVISTO(150),TPVISU(5),TPVIST(5)
      INTEGER NDIV(3),PTRA(6),PTRZ(6),BLTYPE
C
      SING = SIN(GAMMA/57.29578)
      COSG = COS(GAMMA/57.29578)
      TANG = SING / COSG
      IF(BLTYPE.EQ.2) GOTO 35
```

```
C
C HORIZONTAL BLINDS -- START WITH FLOOR + CEILING
C   PV = FLOOR    QV = CEILING
C
      DO 15 I=1,NDIV(2)
      YP = (I-.5) * ROOMD(2) / NDIV(2)
      PV = VISIBL(ROOMD(2)-YP,0.,ROOMD(3),SING,COSG,TANG)
      QV = VISIBL(ROOMD(2)-YP,-ROOMD(3),0.,SING,COSG,TANG)
      ZT1 = -ROOMD(3)
      ZT2 = AMAX1(ZT1,-(ROOMD(2)-YP)*TANG)
      VTO = VISIBL(ROOMD(2)-YP,ZT1,ZT2,SING,COSG,TANG)
      ZU2 = 0.
      VUN = VISIBL(ROOMD(2)-YP,ZT2,ZU2,SING,COSG,TANG)
      RATIO = TSRAT(ZT2,ZT1,ROOMD(2)-YP)
      DO 14 J=1,NDIV(1)
      INC = (J-1)*NDIV(2) + I - 1
      PVISUN(PTRA(5)+INC) = 1.- PV
      PVISUN(PTRA(6)+INC) = (1.-VUN) * (ZU2-ZT2) / ROOMD(3)
      PVISTO(PTRA(5)+INC) = 0.
      PVISTO(PTRA(6)+INC) = (1.-VTO) * (ZT2-ZT1) * RATIO / ROOMD(3)
      PVISU(PTRA(5)+INC) = PV
      PVISL(PTRA(5)+INC) = 0.
      PVISL(PTRA(6)+INC) = QV
   14 PVISU(PTRA(6)+INC) = 0.
   15 CONTINUE
C
C NEXT, THE SOUTH WALL
C
      DO 20 I=1,NDIV(3)
      ZP = (I-.5) * ROOMD(3) / NDIV(3)
      PV = VISIBL(ROOMD(2),0.,ROOMD(3)-ZP,SING,COSG,TANG)
      QV = VISIBL(ROOMD(2),-ZP,0.,SING,COSG,TANG)
      ZT1 = -ZP
      ZT2 = AMAX1(ZT1,-ROOMD(2)*TANG)
      VTO = VISIBL(ROOMD(2),ZT1,ZT2,SING,COSG,TANG)
      ZU2 = ROOMD(3)-ZP
      VUN = VISIBL(ROOMD(2),ZT2,ZU2,SING,COSG,TANG)
      RATIO = TSRAT(ZT2,ZT1,ROOMD(2))
      DO 19 J=1,NDIV(1)
      L = PTRA(4) + I - 1 + (J-1)*NDIV(3)
      PVISTO(L) = (1.-VTO) * (ZT2-ZT1) * RATIO / ROOMD(3)
      PVISUN(L) = (1.-VUN) * (ZU2-ZT2) / ROOMD(3)
      PVISL(L) = QV * ZP / ROOMD(3)
   19 PVISU(L) = PV * (ROOMD(3)-ZP) / ROOMD(3)
   20 CONTINUE
C
C EAST AND WEST WALLS
C
      L = -1
      DO 25 I=1,NDIV(2)
```

```
      YP = (I-.5) * ROOMD(2) / NDIV(2)
      DO 24 J=1,NDIV(3)
      ZP = (J-.5) * ROOMD(3) / NDIV(3)
      PV = VISIBL(ROOMD(2)-YP,0.,ROOMD(3)-ZP,SING,COSG,TANG)
      QV = VISIBL(ROOMD(2)-YP,-ZP,0.,SING,COSG,TANG)
      ZT1 = -ZP
      ZT2 = AMAX1(ZT1,-(ROOMD(2)-YP)*TANG)
      VTO = VISIBL(ROOMD(2)-YP,ZT1,ZT2,SING,COSG,TANG)
      ZU2 = ROOMD(3)-ZP
      VUN = VISIBL(ROOMD(2)-YP,ZT2,ZU2,SING,COSG,TANG)
      RATIO = TSRAT(ZT2,ZT1,ROOMD(2)-YP)
      L = L + 1
      PVISTO(PTRA(1)+L) = (1.-VTO) * (ZT2-ZT1) * RATIO / ROOMD(3)
      PVISTO(PTRA(3)+L) = PVISTO(PTRA(1)+L)
      PVISUN(PTRA(1)+L) = (1.-VUN) * (ZU2-ZT2) / ROOMD(3)
      PVISUN(PTRA(3)+L) = PVISUN(PTRA(1)+L)
      PVISL(PTRA(1)+L) = QV * ZP / ROOMD(3)
      PVISL(PTRA(3)+L) = QV * ZP / ROOMD(3)
      PVISU(PTRA(1)+L) = PV * (ROOMD(3)-ZP) / ROOMD(3)
   24 PVISU(PTRA(3)+L) = PV * (ROOMD(3)-ZP) / ROOMD(3)
   25 CONTINUE
C
C FINALLY THE TARGET POINTS
C
      DO 30 I=1,5
      TPVIS(I) = VISIBL((.2*I-.1)*ROOMD(2),0.,ROOMD(3),SING,COSG,TANG)
      TPVIST(I) = 0.
   30 TPVISU(I) = 1. - TPVIS(I)
      GOTO 60
C
C VERTICAL BLINDS -- FLOOR AND CEILING FIRST
C
   35 CONTINUE
      L = -1
      DO 40 J=1,NDIV(1)
      XP = (J-.5) * ROOMD(1) / NDIV(1)
      DO 39 I=1,NDIV(2)
      YP = (I-.5) * ROOMD(2) / NDIV(2)
      PV = VISIBL(ROOMD(2)-YP,XP-ROOMD(1),XP,SING,COSG,TANG)
      ZT1 = XP - ROOMD(1)
      ZT2 = AMAX1(ZT1,-(ROOMD(2)-YP)*TANG)
      VTO = VISIBL(ROOMD(2)-YP,ZT1,ZT2,SING,COSG,TANG)
      ZU2 = XP
      VUN = VISIBL(ROOMD(2)-YP,ZT2,ZU2,SING,COSG,TANG)
      RATIO = TSRAT(ZT2,ZT1,ROOMD(2)-YP)
      L = L + 1
      PVISTO(PTRA(5)+L) = (1.-VTO) * (ZT2-ZT1) * RATIO / ROOMD(1)
      PVISTO(PTRA(6)+L) = PVISTO(PTRA(5)+L)
      PVISUN(PTRA(5)+L) = (1.-VUN) * (ZU2-ZT2) / ROOMD(1)
      PVISUN(PTRA(6)+L) = PVISUN(PTRA(5)+L)
```

```
      PVISU(PTRA(5)+L) = PV
      PVISU(PTRA(6)+L) = 0.
      PVISL(PTRA(5)+L) = 0.
   39 PVISL(PTRA(6)+L) = PV
   40 CONTINUE
C
C  SOUTH WALL
C
      L = -1
      DO 45 J=1,NDIV(1)
      XP = (J-.5) * ROOMD(1) / NDIV(1)
      PV = VISIBL(ROOMD(2),XP-ROOMD(1),XP,SING,COSG,TANG)
      ZT1 = XP - ROOMD(1)
      ZT2 = AMAX1(ZT1,-ROOMD(2)*TANG)
      VTO = VISIBL(ROOMD(2),ZT1,ZT2,SING,COSG,TANG)
      ZU2 = XP
      VUN = VISIBL(ROOMD(2),ZT2,ZU2,SING,COSG,TANG)
      RATIO = TSRAT(ZT2,ZT1,ROOMD(2))
      DO 44 I=1,NDIV(3)
      L = L + 1
      ZP = (I-.5)* ROOMD(3) / NDIV(3)
      PVISTO(PTRA(4)+L) = (1.-VTO) * (ZT2-ZT1) * RATIO / ROOMD(1)
      PVISUN(PTRA(4)+L) = (1.-VUN) * (ZU2-ZT2) / ROOMD(1)
      PVISL(PTRA(4)+L) = PV * ZP / ROOMD(3)
   44 PVISU(PTRA(4)+L) = PV * (ROOMD(3)-ZP) / ROOMD(3)
   45 CONTINUE
C
C WEST, EAST WALLS  (PV = WEST WALL,  QV = EAST WALL)
C
      L = -1
      DO 50 J=1,NDIV(2)
      YP = (J-.5) * ROOMD(2) / NDIV(2)
      PV = VISIBL(ROOMD(2)-YP,-ROOMD(1),0.,SING,COSG,TANG)
      QV = VISIBL(ROOMD(2)-YP,0.,ROOMD(1),SING,COSG,TANG)
      ZT1W = -ROOMD(1)
      ZT2W = AMAX1(ZT1W,-(ROOMD(2)-YP)*TANG)
      VTWEST = VISIBL(ROOMD(2)-YP,ZT1W,ZT2W,SING,COSG,TANG)
      RATIO = TSRAT(ZT2W,ZT1W,ROOMD(2)-YP)
      ZU2W = 0.
      VUWEST = VISIBL(ROOMD(2)-YP,ZT2W,ZU2W,SING,COSG,TANG)
      VUEAST = VISIBL(ROOMD(2)-YP,0.,ROOMD(1),SING,COSG,TANG)
      DO 49 I=1,NDIV(3)
      L = L + 1
      PVISTO(PTRA(1)+L) = (1.-VTWEST) * (ZT2W-ZT1W) * RATIO / ROOMD(1)
      PVISUN(PTRA(1)+L) = (1.-VUWEST) * (ZU2W-ZT2W) / ROOMD(1)
      PVISTO(PTRA(3)+L) = 0.
      PVISUN(PTRA(3)+L) = 1. - VUEAST
      PVISU(PTRA(1)+L) = PV * (ROOMD(3)-ZP) / ROOMD(3)
      PVISU(PTRA(3)+L) = QV * (ROOMD(3)-ZP) / ROOMD(3)
      PVISL(PTRA(1)+L) = PV * ZP / ROOMD(3)
```

```
   49  PVISL(PTRA(3)+L) = OV * ZP / ROOMD(3)
   50  CONTINUE
C
C FINALLY, THE TARGET POINTS
C
       DO 55 I=1,5
       Y = (.2*I - .1) * ROOMD(2)
       TPVIS(I) = VISIBL(Y,-.5*ROOMD(1),.5*ROOMD(1),SING,COSG,TANG)
       ZT1 = -.5*ROOMD(1)
       ZT2 = AMAX1(ZT1,-Y*TANG)
       VTO = VISIBL(Y,ZT1,ZT2,SING,COSG,TANG)
       ZU2 = .5*ROOMD(1)
       VUN = VISIBL(Y,ZT2,ZU2,SING,COSG,TANG)
       TPVIST(I) = (1.-VTO) * (ZT2-ZT1) / ROOMD(1)
       TPVISU(I) = (1.-VUN) * (ZU2-ZT2) / ROOMD(1)
   55  CONTINUE
C
C COMPLEMENT THE TOPSIDE-UNDERSIDE PERCENTAGES
C
   60  CONTINUE
       DO 62 I=PTRA(1),PTRZ(6)
       PVISUN(I) = 1.- PVISUN(I)
       PVISTO(I) = 1.- PVISTO(I)
   62  CONTINUE
C
       DO 64 I=1,5
       TPVIST(I) = 1.- TPVIST(I)
   64  TPVISU(I) = 1.- TPVISU(I)
       RETURN
       END
C-----------------------------------------------------------
C FORM RATIO USED TO ACCOUNT FOR THE FACT THAT TOPSIDE OF
C BLINDS ARE ONLY VISIBLE SOME DISTANCE AWAY
C
       FUNCTION TSRAT(X1,X2,Z)
       TSRAT = 0.
       E1 = 2./Z - 2./SQRT(X1*X1+Z*Z)
       E2 = 2./Z - 2./SQRT(X2*X2+Z*Z)
       IF(E2.GT.0.001) TSRAT = (E2-E1) / E2
       RETURN
       END
C-----------------------------------------------------------
C RETURN FORM FACTORS, INITIAL ILLUMINANCE FROM SUN ON BLINDS
C  SING,COSG - SINE, COSINE OF BLINDS OPENING ANGLE
C  TANA  - TANGENT OF PROFILE ANGLE
C
       SUBROUTINE SOLFF(SING,COSG,TANA,E1,E2,F12,F13
      &  ,F21,F31,FC)
       F13 = 0.
       F31 = 0.
```

```
      F21 = F12
      X = 1. - 1.15 *(SING + COSG*TANA)
      E1 = 0.
      E2 = FC / 1.15
      IF(X.GT.0.) E2 = FC * (1.-X) / 1.15
      IF(X.GT.0.) RETURN
C
      A3 = 1.15 - 1./ (COSG*TANA + SING)
      ZSQ = COSG * COSG
      U1 = SING
      U2 = U1 + A3
      F13 = .43478 * (SQRT(U2*U2+ZSQ)
     & -SQRT(U1*U1+ZSQ) -SQRT((1.15-U2)**2 +ZSQ)
     &   + SQRT((1.15-U1)**2 + ZSQ))
C
      U1 = U2
      U2 = SING + 1.15
      F12 = .43478 * (SQRT(U2*U2+ZSQ) - SQRT(U1*U1+ZSQ)
     &  -SQRT((1.15-U2)**2 +ZSQ) + SQRT((1.15-U1)**2 + ZSQ))
      IF(A3.GT.0.001) F31 = F13 / A3
      F21 = F12 * 1.15 / (1.15-A3)
      E2 = FC  / (1.15-A3)
      RETURN
      END
C-----------------------------------------------------------
C FUNCTION GIVES LOSSES DUE TO INCIDENT ANGLE ON GLAZED
C WINDOW.  FORMULA IS FROM RIVERO, AS GIVEN BY BRYAN
C  (JIES, JULY 1981, PP. 219-227)
C   X,Y,Z - LOCATION OF PT ON WINDOW, RELATIVE TO TARGET PT
C      D   - DISTANCE FROM TARGET PT TO PT ON WINDOW
C
      FUNCTION TLOSS(X,Y,Z,D)
      TLOSS = 1.018 * (Y/D) * (1.+ ( (X*X+Z*Z)**1.5 ) / (D*D*D) )
      RETURN
      END
C-----------------------------------------------------------
C RETURN PROPORTION OF OUTSIDE SKY VISIBLE THRU BLINDS
C  Y  - DISTANCE FROM WINDOW TO TARGET PT
C  Z1,Z2 - Z-SPAN OF WINDOW
C  SING,COSG,TANG - SINE,COSINE,TANGENT OF BLINDS OPENING ANGLE
C
      FUNCTION VISIBL(Y,Z1,Z2,SING,COSG,TANG)
      X1 = -Y * ( (1. + 1.15 * SING) / (1.15 * COSG) )
      X2 = Y * ( (1. - 1.15 * SING) / (1.15 * COSG) )
      VISIBL = 0.
       IF(Z1.GE.X2 .OR. Z2.LE.X1 .OR. Z2.LE.Z1) RETURN
      X0 = -Y * TANG
      X1 = AMAX1(Z1,X1)
      X2 = AMIN1(Z2,X2)
      X0 = AMAX1(X1,AMIN1(X0,X2))
```

```
      VISIBL = (X2 - X1 + 1.15*SING * (2.*X0 -X1 -X2)
     &  + (1.15*COSG/(2.*Y)) * (2.*X0*X0 -X1*X1 -X2*X2) )
     &    / (Z2-Z1)
      RETURN
      END
C
C COMMON FOR SIMPSON INTEGRAND, LABEL STORAGE
C
      COMMON /CSIMP/ FS(51,201)
      REAL RDESC(20,2,56)
      EQUIVALENCE (FS,RDESC)
C
C-----------------------------------------------------------------
C THIS PROGRAM COMPUTES TABLES OF MULTIPLIERS FOR EACH BLINDS
C ANGLE
C                      SOLAR COMPONENT
C
C
C CU(I,J,K,L) - CU VALUE FOR PROFILE ANGLE I, REFLECTANCE J,
C               BLINDS ANGLE K, SIDE OF BLINDS L
C RHOB  - BLINDS REFLECTANCE
C PROFA - PROFILE ANGLE
C BLINDA - BLINDS ANGLE
C FF    - FORM FACTORS FOR EACH BLINDS ANGLE
C
      PROGRAM SUNMUL
      REAL CU(6,5,6,2),RHOB(5),PROFA(6),BLINDA(6),FF(6),L1,L2,L3
      CHARACTER NAME*16
C
      DATA RHOB/.1,.3,.5,.7,.9/, PROFA/0.,15.,30.,45.,60.,75./
     & ,BLINDA/0.,15.,30.,45.,60.,75./
     & ,FF/.4556,.4445,.4114,.3572,.2835,.1953/
C
C OUTER LOOP ON BLINDS ANGLES
C
      DO 100 K=1,6
      SING = SIN(BLINDA(K)/57.29578)
      COSG = COS(BLINDA(K)/57.29578)
C
C NEXT LOOP ON PROFILE ANGLES -- GET INITIAL ILLUM., FORM FACTORS
C
      DO 90 J=1,6
      TANA = TAN(PROFA(J)/57.29578)
      FCLOST = TLOSS(0.,1.,TANA,SQRT(1.+TANA*TANA))
      F12 = FF(K)
      CALL SOLFF(SING,COSG,TANA,E1,E2,F12,F13,F21,F31,1000.*FCLOST)
C
C SAVE WIDTH OF BRIGHT STRIP ON TOPSIDE (SURFACE 2)
C
      STRIP = 1.15
```

```
      IF(J*K.NE.1) STRIP = 1. / (COSG*TANA + SING)
      STRIP = AMAX1(0.,AMIN1(1.15,STRIP))
C
C LOOP ON REFLECTANCES, COMPUTE FINAL EXITANCES
C
      DO 80 I=1,5
      R = RHOB(I)
      DENOM = 1. - R*R*(F13*F31 + F12*F21)
      L1 = R * (E1 + R*F12*E2) / DENOM
      L2 = R * (E2 + R*E1*F21 - R*R*E2*F13*F31) / DENOM
      L3 = R*R * (E1*F31 + R*E2*F12*F31) / DENOM
      CU(J,I,K,1) = L1
      CU(J,I,K,2) = (STRIP*L2 + (1.15-STRIP)*L3) / 1.15
   80 CONTINUE
   90 CONTINUE
  100 CONTINUE
C
C PRINT THE RESULTS
C
      PRINT 1001
 1001 FORMAT(/' -ENTER OUTPUT FILE NAME:')
      ACCEPT 1002,NAME
 1002 FORMAT(A)
      OPEN(UNIT=2,FILE=NAME,STATUS='UNKNOWN')
C
      DO 120 M=1,2
      WRITE(2,1003)
 1003 FORMAT('1'//29X,'SOLAR BLINDS MULTIPLIERS')
      IF(M.EQ.1) WRITE(2,1004)
 1004 FORMAT(/21X'-- UNDERSIDE, SURFACE HIDDEN FROM SUN --')
      IF(M.EQ.2) WRITE(2,1005)
 1005 FORMAT(/23X'-- TOPSIDE, SURFACE EXPOSED TO SUN --')
      DO 110 K=1,5,2
      WRITE(2,1006) NINT(BLINDA(K)),NINT(BLINDA(K+1))
     & ,(NINT(PROFA(I)),(NINT(CU(I,J,K,M)),J=1,5)
     & ,(NINT(CU(I,J,K+1,M)),J=1,5),I=1,6)
 1006 FORMAT(///18X'BLINDS ANGLE = ',I3,'  DEG  ||'
     & ,'  BLINDS ANGLE = ',I3,'  DEG'
     & /8X'|-------|',26('-'),'||',26('-'),'|'
     & /8X'| SOLAR ',2('|    BLINDS REFLECTANCE    |')
     & /8X'|PROFILE|',26X,'||',26X,'|'
     & /8X'| ANGLE ',2('|  10%  30%  50%  70%  90% |')
     & /8X'|-------|',26('-'),'||',26('-'),'|'
     & / (8X,'|',I5,'  |',5I5.3,' ||',5I5.3,' |') )
      WRITE(2,1007)
 1007 FORMAT(8X,'|-------|',26('-'),'||',26('-'),'|')
  110 CONTINUE
  120 CONTINUE
      STOP
      END
```

AD-A134 028 DAYLIGHTING COEFFICIENT OF UTILIZATION TABLES(U) 2/2
APPLIED SOFTWARE ANALYSIS BOULDER CO W E BRACKETT
AUG 83 NCEL-CR-83.038 N62583-83-MR-513

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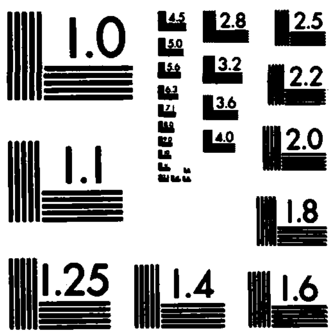
END



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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C-------------------------------------------------------------
C THIS PROGRAM COMPUTES TABLES OF MULTIPLIERS FOR EACH BLINDS
C ANGLE
C                     SKY COMPONENT  &  GROUND COMPONENT
C
C CU(I,J,L) - CU VALUE FOR BLINDS ANGLE I, REFLECTANCE J, BLINDS SIDE L
C RHOB   - BLINDS REFLECTANCE
C BLINDA - BLINDS ANGLE
C FF     - FORM FACTORS FOR EACH BLINDS ANGLE
C
      PROGRAM SKYMUL
      REAL CU(6,5,2), RHOB(5),BLINDA(6),FF(6),L1,L2
      CHARACTER NAME*16
C
      DATA RHOB/.1,.3,.5,.7,.9/
     & ,BLINDA/0.,15.,30.,45.,60.,75./
     & ,FF/.4556,.4445,.4114,.3572,.2835,.1953/
C
C OUTER LOOP ON BLINDS ANGLES
C
      DO 100 K=1,6
      SING = SIN(BLINDA(K)/57.29578)
      COSG = COS(BLINDA(K)/57.29578)
C
C COMPUTE INITIAL ILLUMINANCES
C
      Z2 = (1.-.575*SING) / (.575*COSG)
      E1 = 0.
      E2 = 1000.* SING * Z2 / SQRT(1.+Z2*Z2)
     &    + 1000. * COSG * (1. - 1./SQRT(1.+Z2*Z2))
C
C LOOP ON REFLECTANCES, COMPUTE FINAL EXITANCES
C
      DO 80 I=1,5
      CU(K,I,1) = RHOB(I) * (E1 + RHOB(I)*E2*FF(K))
     &  / (1. - RHOB(I)*RHOB(I)*FF(K)*FF(K))
      CU(K,I,2) = RHOB(I) * (E2 + RHOB(I)*E1*FF(K))
     &  / (1. - RHOB(I)*RHOB(I)*FF(K)*FF(K))
  80  CONTINUE
 100  CONTINUE
C
C PRINT THE RESULTS
C
      PRINT 1001
 1001 FORMAT(/' -ENTER OUTPUT FILE NAME:')
      ACCEPT 1002,NAME
 1002 FORMAT(A)
      OPEN(UNIT=2,FILE=NAME,STATUS='UNKNOWN')
C
      WRITE(2,1003)
```

```
 1003 FORMAT('1'/////30X,'SKY BLINDS MULTIPLIERS')
      DO 120 M=1,2
      IF(M.EQ.1) WRITE(2,1004)
 1004 FORMAT(/////21X'-- UNDERSIDE, SURFACE HIDDEN FROM SUN --')
      IF(M.EQ.2) WRITE(2,1005)
 1005 FORMAT(/////23X'-- TOPSIDE, SURFACE EXPOSED TO SUN --')
      WRITE(2,1006) (NINT(BLINDA(I)),(NINT(CU(I,J,M)),J=1,5),I=1,6)
 1006 FORMAT(//18X'|-------|',26('-'),'|'
     & /18X'|       |     BLINDS REFLECTANCE    |'
     & /18X'| BLINDS|',26X,'|'
     & /18X'| ANGLE |  10%  30%  50%  70%  90% |'
     & /18X'|-------|',26('-'),'|'
     & / (18X,'|',I5,'  |',5I5.3,' |') )
      WRITE(2,1007)
 1007 FORMAT(18X,'|-------|',26('-'),'|')
 120  CONTINUE
C
C NOW DO GROUND MULTIPLIERS -- LOOP ON BLINDS ANGLES
C
      DO 200 K=1,6
      SING = SIN(BLINDA(K)/57.29578)
      COSG = COS(BLINDA(K)/57.29578)
C
C GET INITIAL ILLUMINANCES
C
      Y1 = .575 * COSG  / (1. + .575 * SING)
      Y2 = 10.**6.
      IF(SING.GT.0.0001) Y2 = COSG / SING
      SY2 = SQRT(Y2*Y2+1.)
      SY1 = SQRT(Y1*Y1+1.)
      E1 = 500.* (COSG * (Y2/SY2 - Y1/SY1) - SING*(1./SY1 - 1./SY2))
      E2 = 500.* (SING/SY2 - COSG*(1.- Y2/SY2))
C
C LOOP ON REFLECTANCES
C
      DO 180 I=1,5
      CU(K,I,1) = RHOB(I) * (E1 + RHOB(I)*E2*FF(K))
     & / (1. - RHOB(I)*RHOB(I)*FF(K)*FF(K))
      CU(K,I,2) = RHOB(I) * (E2 + RHOB(I)*E1*FF(K))
     & / (1. - RHOB(I)*RHOB(I)*FF(K)*FF(K))
 180  CONTINUE
 200  CONTINUE
C
C PRINT THESE RESULTS
C
      WRITE(2,1008)
 1008 FORMAT('1'/////28X'GROUND BLINDS MULTIPLIERS')
      DO 220 M=1,2
      IF(M.EQ.1) WRITE(2,1004)
      IF(M.EQ.2) WRITE(2,1005)
```

```
      WRITE(2,1006) (NINT(BLINDA(I)),(NINT(CU(I,J,M)),J=1,5),I=1,6)
      WRITE(2,1007)
220   CONTINUE
      STOP
      END
 1 ILLUMINANCE FROM SKY --  V/H = 0.75
   NO BLINDS
 2 ILLUMINANCE FROM SKY --  V/H = 1.00 (UNIFORM SKY)
   NO BLINDS
 3 ILLUMINANCE FROM SKY --  V/H = 1.25
   NO BLINDS
 4 ILLUMINANCE FROM SKY --  V/H = 1.50
   NO BLINDS
 5 ILLUMINANCE FROM SKY --  V/H = 1.75
   NO BLINDS
 6 ILLUMINANCE FROM SKY -- L = LZ * (1 + 2 SIN H) / 3
   NO BLINDS
 7 ILLUMINANCE FROM SKY -- L = 3LZ / (1 + 2 SIN H)
   NO BLINDS
 8 ILLUMINANCE FROM GROUND
   NO BLINDS
 9 ILLUMINANCE FROM SKY -- THRU COMPONENT
   HORIZONTAL BLINDS, ANGLE = 0
10 ILLUMINANCE FROM SKY -- THRU COMPONENT
   HORIZONTAL BLINDS, ANGLE = 15
11 ILLUMINANCE FROM SKY -- THRU COMPONENT
   HORIZONTAL BLINDS, ANGLE = 30
12 ILLUMINANCE FROM SKY -- THRU COMPONENT
   HORIZONTAL BLINDS, ANGLE = 45
13 ILLUMINANCE FROM SKY -- THRU COMPONENT
   HORIZONTAL BLINDS, ANGLE = 60
14 ILLUMINANCE FROM SKY -- THRU COMPONENT
   HORIZONTAL BLINDS, ANGLE = 75
15 ILLUMINANCE FROM SKY -- THRU COMPONENT
   VERTICAL BLINDS, ANGLE = 0
16 ILLUMINANCE FROM SKY -- THRU COMPONENT
   VERTICAL BLINDS, ANGLE = 15
17 ILLUMINANCE FROM SKY -- THRU COMPONENT
   VERTICAL BLINDS, ANGLE = 30
18 ILLUMINANCE FROM SKY -- THRU COMPONENT
   VERTICAL BLINDS, ANGLE = 45
19 ILLUMINANCE FROM SKY -- THRU COMPONENT
   VERTICAL BLINDS, ANGLE = 60
20 ILLUMINANCE FROM SKY -- THRU COMPONENT
   VERTICAL BLINDS, ANGLE = 75
21 ILLUMINANCE FROM GROUND -- THRU COMPONENT
   HORIZONTAL BLINDS, ANGLE = 0
22 ILLUMINANCE FROM GROUND -- THRU COMPONENT
   HORIZONTAL BLINDS, ANGLE = 15
23 ILLUMINANCE FROM GROUND -- THRU COMPONENT
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```
   HORIZONTAL BLINDS, ANGLE = 30
24 ILLUMINANCE FROM GROUND -- THRU COMPONENT
   HORIZONTAL BLINDS, ANGLE = 45
25 ILLUMINANCE FROM GROUND -- THRU COMPONENT
   HORIZONTAL BLINDS, ANGLE = 60
26 ILLUMINANCE FROM GROUND -- THRU COMPONENT
   HORIZONTAL BLINDS, ANGLE = 75
27 ILLUMINANCE FROM GROUND -- THRU COMPONENT
   VERTICAL BLINDS, ANGLE = 0
28 ILLUMINANCE FROM GROUND -- THRU COMPONENT
   VERTICAL BLINDS, ANGLE = 15
29 ILLUMINANCE FROM GROUND -- THRU COMPONENT
   VERTICAL BLINDS, ANGLE = 30
30 ILLUMINANCE FROM GROUND -- THRU COMPONENT
   VERTICAL BLINDS, ANGLE = 45
31 ILLUMINANCE FROM GROUND -- THRU COMPONENT
   VERTICAL BLINDS, ANGLE = 60
32 ILLUMINANCE FROM GROUND -- THRU COMPONENT
   VERTICAL BLINDS, ANGLE = 75
33 ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
   HORIZONTAL BLINDS, ANGLE = 0
34 ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
   HORIZONTAL BLINDS, ANGLE = 15
35 ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
   HORIZONTAL BLINDS, ANGLE = 30
36 ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
   HORIZONTAL BLINDS, ANGLE = 45
37 ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
   HORIZONTAL BLINDS, ANGLE = 60
38 ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
   HORIZONTAL BLINDS, ANGLE = 75
39 ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
   VERTICAL BLINDS, ANGLE = 0
40 ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
   VERTICAL BLINDS, ANGLE = 15
41 ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
   VERTICAL BLINDS, ANGLE = 30
42 ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
   VERTICAL BLINDS, ANGLE = 45
43 ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
   VERTICAL BLINDS, ANGLE = 60
44 ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
   VERTICAL BLINDS, ANGLE = 75
45 ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
   HORIZONTAL BLINDS, ANGLE = 0
46 ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
   HORIZONTAL BLINDS, ANGLE = 15
47 ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
   HORIZONTAL BLINDS, ANGLE = 30
48 ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
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   HORIZONTAL BLINDS, ANGLE = 45
49 ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
   HORIZONTAL BLINDS, ANGLE = 60
50 ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
   HORIZONTAL BLINDS, ANGLE = 75
51 ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
   VERTICAL BLINDS, ANGLE = 0
52 ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
   VERTICAL BLINDS, ANGLE = 15
53 ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
   VERTICAL BLINDS, ANGLE = 30
54 ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
   VERTICAL BLINDS, ANGLE = 45
55 ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
   VERTICAL BLINDS, ANGLE = 60
56 ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
   VERTICAL BLINDS, ANGLE = 75
C-------------------------------------------------------------
C USE 32-INTERVAL SIMPSON INTEGRATION TO DETERMINE VERTICAL
C ILLUMINANCE FROM VARIOUS SKIES -- ASSUME UNIT ZENITH LUMINANCE
C
      PROGRAM EVERT
      REAL F(33)
C
      DATA PI/3.1415927/
C
      OPEN(UNIT=1,FILE='SYS$INPUT',STATUS='OLD')
 10   WRITE(1,1001)
1001  FORMAT(/' -WHICH SKY (1-7) ?')
      READ(1,*) ISKY
      IF(ISKY.LE.0) STOP
C
C COMPUTE SIMPSON INTEGRAND
C
      DO 20 I=1,32
      THETA = (I-1)*0.5* PI / 32.
      Z = TAN(THETA)
      F(I) = COS(THETA)**2. * SKYBR(ISKY,0.,1.,Z
     * ,SQRT(1.+Z*Z))
 20   CONTINUE
      F(33) = 0.
      WRITE(1,1002) (2./PI) * SIMPSN(.5*PI,32,F)
1002  FORMAT(F10.6,' = VERTICAL ILLUMINANCE')
      GOTO 10
      END
C-------------------------------------------------------------
C SIMPSON INTEGRATION OVER N INTERVALS SPANNING 'X'
C
      FUNCTION SIMPSN(X,N,F)
      REAL F(33)
```

```
C
      SIMPSN = F(1) + F(N+1)
      DO 20 I=2,N,2
   20 SIMPSN = SIMPSN + 4.* F(I)
      DO 25 I=3,N-1,2
   25 SIMPSN = SIMPSN + 2.* F(I)
      SIMPSN = SIMPSN * X / (3.*N)
      RETURN
      END
```

ILLUMINANCE FROM SKY -- V/H = 0.75
NO BLINDS

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	824	864	870	873	875	879	880	883
	30	547	711	777	789	793	798	799	801
1	50	355	526	635	659	666	669	670	672
	70	243	386	505	538	548	544	545	547
	90	185	304	418	451	464	444	446	447
	10	667	781	809	812	813	815	816	824
	30	269	416	519	544	551	556	557	563
2	50	122	204	287	319	331	339	341	345
	70	068	116	173	201	214	223	226	229
	90	050	084	127	151	164	167	171	172
	10	522	681	739	746	747	749	747	766
	30	139	232	320	350	360	366	364	373
3	50	053	092	139	163	174	183	182	187
	70	031	053	081	097	106	116	116	119
	90	025	041	061	074	082	089	090	092
	10	405	576	658	670	673	675	674	707
	30	075	134	197	224	235	243	243	255
4	50	028	050	078	094	104	112	114	119
	70	018	031	048	059	065	073	074	078
	90	016	026	040	048	053	059	061	064
	10	242	392	494	516	521	524	523	588
	30	027	054	086	102	111	119	120	135
6	50	011	023	036	044	049	055	056	063
	70	009	018	027	032	035	040	041	046
	90	008	016	023	028	031	034	035	040
	10	147	257	352	380	387	391	392	482
	30	012	026	043	054	060	067	070	086
8	50	006	013	021	026	029	033	035	043
	70	005	011	017	021	023	026	027	034
	90	004	010	015	019	021	023	025	030
	10	092	168	248	275	284	290	291	395
	30	006	014	026	032	036	041	044	059
10	50	003	008	014	017	019	022	024	032
	70	003	007	012	014	016	018	019	026
	90	003	006	011	013	015	016	017	024

ILLUMINANCE FROM SKY -- V/H = 1.00 (UNIFORM SKY)
NO BLINDS

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	671	704	711	715	717	726	726	728
	30	458	595	654	668	672	682	683	685
1	50	313	462	563	589	598	607	608	610
	70	227	362	478	515	527	530	532	534
	90	186	306	424	465	481	468	471	472
	10	545	636	658	660	661	665	666	672
	30	239	367	459	484	491	499	501	506
2	50	121	203	286	320	335	348	351	355
	70	074	128	192	226	243	259	264	267
	90	058	101	156	188	207	215	221	223
	10	431	561	607	613	614	616	615	631
	30	133	223	306	337	348	357	357	366
3	50	058	103	155	183	197	211	213	218
	70	037	063	098	119	132	147	150	154
	90	030	051	079	098	110	122	126	129
	10	339	482	549	560	563	566	565	593
	30	078	139	204	234	247	258	260	272
4	50	033	060	094	114	126	139	143	150
	70	022	039	061	074	083	095	099	104
	90	019	032	050	061	070	080	084	089
	10	211	343	433	453	458	461	461	518
	30	033	065	103	123	135	145	148	167
6	50	015	029	047	057	064	073	077	086
	70	011	021	033	040	045	051	054	060
	90	010	019	028	034	038	044	046	052
	10	135	238	326	353	362	366	367	452
	30	016	034	058	072	080	090	094	116
8	50	008	017	027	034	039	045	048	059
	70	006	013	021	026	028	032	035	043
	90	005	012	019	023	025	029	031	038
	10	090	165	244	272	283	290	291	395
	30	009	020	036	045	052	060	064	087
10	50	005	010	019	023	026	030	033	044
	70	004	009	015	018	020	023	025	033
	90	003	008	014	016	018	020	022	030

ILLUMINANCE FROM SKY -- V/H = 1.25
NO BLINDS

ROOM DEPTH / WINDOW HEIGHT D / H	% D	.5	1	2	3	4	6	8	INF
	10	578	607	614	619	621	633	634	635
	30	405	525	580	594	599	612	614	615
1	50	287	423	519	547	556	569	571	573
	70	218	347	461	501	515	522	525	526
	90	186	307	428	473	491	483	486	487
	10	472	549	566	569	570	574	575	581
	30	221	337	422	447	456	465	467	472
2	50	120	202	285	321	337	353	357	361
	70	078	136	204	242	261	281	287	290
	90	064	112	174	211	233	244	251	253
	10	377	488	527	533	534	536	536	549
	30	130	217	298	329	341	352	353	362
3	50	062	110	165	195	211	228	231	237
	70	040	070	109	132	147	166	171	175
	90	033	057	090	112	127	142	148	152
	10	300	424	484	494	497	499	499	524
	30	080	143	209	240	255	267	269	283
4	50	036	066	104	126	140	156	160	168
	70	024	043	068	083	094	109	115	120
	90	021	036	056	070	080	092	099	103
	10	193	314	395	415	420	423	423	476
	30	036	071	113	136	149	161	165	186
6	50	017	033	053	065	074	084	089	100
	70	012	024	037	045	050	058	061	069
	90	011	021	031	038	043	049	053	060
	10	128	226	310	337	346	351	352	433
	30	019	039	066	082	092	104	109	134
8	50	009	019	031	040	045	052	056	069
	70	007	015	023	029	032	037	040	049
	90	006	013	021	025	028	032	035	043
	10	088	164	241	270	282	290	291	396
	30	011	024	043	054	062	071	076	103
10	50	005	012	022	026	030	035	038	052
	70	004	010	017	020	023	026	028	038
	90	004	009	016	018	020	023	025	034

Column heading over .5 to INF: WINDOW WIDTH / WINDOW HEIGHT W / H

ILLUMINANCE FROM SKY -- V/H = 1.50
NO BLINDS

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	503	528	536	541	544	557	558	559
	30	359	464	514	528	534	549	550	552
1	50	261	384	471	499	508	524	526	527
	70	204	325	432	470	485	497	499	500
	90	179	295	412	456	475	474	477	478
	10	412	477	490	492	493	498	499	505
	30	201	304	379	402	410	422	424	429
2	50	115	192	269	304	320	339	343	347
	70	078	136	204	241	261	286	292	295
	90	066	117	183	221	246	262	271	273
	10	331	426	458	461	462	465	465	477
	30	121	202	275	304	316	327	329	337
3	50	062	109	164	193	209	228	232	238
	70	041	073	114	138	154	176	183	188
	90	035	062	099	123	141	159	169	173
	10	265	372	422	430	433	435	435	456
	30	077	137	199	229	243	256	259	272
4	50	037	069	107	130	144	161	167	175
	70	026	046	073	089	101	119	126	132
	90	022	039	063	078	090	106	114	120
	10	173	281	351	368	373	375	375	422
	30	037	073	115	137	151	164	168	189
6	50	018	036	058	071	080	092	098	110
	70	013	026	040	049	056	064	069	078
	90	012	023	035	043	048	057	062	070
	10	117	207	282	305	314	319	320	393
	30	020	042	071	087	098	111	116	143
8	50	010	021	035	044	050	058	063	078
	70	007	016	026	032	036	041	045	055
	90	007	014	023	028	031	036	040	049
	10	082	153	224	250	262	269	271	368
	30	012	026	047	059	068	078	084	114
10	50	006	014	024	030	034	040	044	060
	70	005	011	019	022	025	029	032	043
	90	004	010	017	020	023	026	028	038

ILLUMINANCE FROM SKY -- V/H = 1.75
NO BLINDS

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	435	457	465	471	474	486	488	489
	30	317	407	452	466	471	486	488	489
1	50	234	343	422	447	456	472	475	476
	70	187	297	395	430	445	458	461	462
	90	168	276	384	426	444	447	450	451
	10	357	412	422	424	424	430	431	436
	30	180	271	335	356	363	375	378	381
2	50	106	177	246	278	293	313	318	321
	70	074	130	194	229	249	274	282	284
	90	065	116	181	219	244	264	273	276
	10	288	369	394	397	397	400	401	411
	30	110	183	247	272	282	294	296	304
3	50	058	104	154	181	196	215	221	226
	70	040	072	112	136	152	176	184	188
	90	035	063	101	126	144	166	177	182
	10	232	324	365	371	373	375	375	394
	30	071	127	183	209	222	235	238	250
4	50	036	067	104	125	139	157	163	171
	70	025	046	072	089	101	119	127	134
	90	022	041	065	082	095	114	124	130
	10	153	247	307	320	324	326	327	367
	30	035	070	109	130	143	155	160	180
6	50	018	036	058	071	080	091	098	110
	70	013	026	041	051	058	067	073	082
	90	012	023	037	046	052	062	069	078
	10	104	184	249	269	276	281	282	346
	30	020	042	070	086	096	109	115	141
8	50	010	022	036	046	052	060	066	081
	70	008	017	027	033	038	044	048	059
	90	007	015	024	030	034	040	044	054
	10	074	138	201	223	233	240	242	328
	30	012	027	048	059	067	078	084	114
10	50	006	014	026	032	036	043	047	064
	70	005	011	020	024	027	031	034	046
	90	004	010	018	022	024	028	031	042

ILLUMINANCE FROM GROUND
NO BLINDS

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	105	137	177	197	207	208	210	211
	30	116	157	203	225	235	241	243	244
1	50	110	165	217	241	252	267	269	270
	70	101	162	217	243	253	283	285	286
	90	091	146	199	230	239	290	292	293
	10	095	124	160	178	186	186	189	191
	30	082	132	179	201	212	219	222	225
2	50	062	113	165	189	202	214	218	220
	70	051	093	141	165	179	194	198	200
	90	045	079	118	140	153	179	183	185
	10	088	120	157	175	183	185	163	167
	30	059	107	154	176	187	198	193	198
3	50	039	074	114	134	146	157	166	170
	70	031	055	085	101	111	122	127	130
	90	028	047	070	083	092	107	113	115
	10	073	113	154	174	183	187	176	184
	30	040	082	127	148	159	170	177	185
4	50	025	049	078	094	103	113	117	123
	70	020	036	054	065	071	079	083	087
	90	019	032	046	054	060	069	073	076
	10	056	106	143	164	175	184	173	194
	30	021	050	081	098	107	117	123	138
6	50	013	027	041	049	054	060	064	072
	70	011	021	029	033	035	039	041	046
	90	011	020	026	030	032	035	037	042
	10	036	082	122	143	156	166	170	208
	30	011	029	050	062	070	078	082	101
8	50	007	016	024	028	031	035	038	046
	70	006	013	018	020	021	023	025	030
	90	006	013	017	019	020	022	023	028
	10	024	061	109	120	131	144	147	200
	30	006	017	034	040	046	053	056	076
10	50	004	010	016	018	020	023	024	033
	70	004	009	013	014	015	016	016	022
	90	004	009	013	013	014	015	016	021

ILLUMINANCE FROM SKY -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 0

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
1	10	036	041	046	048	050	054	055	055
	30	061	084	097	101	103	108	108	108
	50	065	102	129	137	140	144	144	145
	70	062	106	146	159	164	163	164	165
	90	061	109	158	175	182	172	173	174
2	10	051	061	066	067	069	070	071	072
	30	058	093	121	129	132	136	136	138
	50	044	077	115	131	139	145	147	148
	70	031	059	095	114	125	133	136	137
	90	025	048	082	102	115	115	119	120
3	10	058	077	085	087	088	089	090	092
	30	046	080	115	128	134	138	140	144
	50	026	050	080	098	108	116	120	123
	70	016	030	052	066	075	085	090	092
	90	011	023	041	053	062	068	073	075
4	10	060	086	099	102	103	104	105	110
	30	035	063	097	114	122	128	130	137
	50	016	031	052	066	075	084	088	092
	70	009	018	031	041	047	056	061	063
	90	007	013	024	032	038	043	048	050
6	10	055	090	115	120	122	123	124	140
	30	018	035	059	073	082	090	093	105
	50	007	014	025	033	039	046	050	056
	70	004	009	016	020	024	029	032	036
	90	003	007	012	016	018	022	026	029
8	10	047	082	114	124	127	129	130	159
	30	010	020	036	046	053	061	064	079
	50	004	008	015	020	023	028	031	039
	70	003	006	010	013	015	018	020	025
	90	002	005	008	011	012	015	016	020
10	10	038	070	105	118	123	127	127	173
	30	006	012	023	030	036	042	046	062
	50	002	005	010	013	016	019	022	030
	70	002	004	008	009	011	013	015	020
	90	001	004	007	008	009	011	012	017

ILLUMINANCE FROM SKY -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 15

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	019	023	027	030	031	037	040	040
	30	032	044	052	054	056	061	061	062
1	50	034	053	068	073	074	078	079	079
	70	032	055	076	084	086	089	089	089
	90	032	057	082	091	095	093	094	094
	10	026	032	035	037	038	040	041	041
	30	030	048	063	068	070	072	073	074
2	50	023	041	060	069	073	077	078	079
	70	017	032	052	063	068	073	075	075
	90	014	028	049	060	068	068	071	071
	10	030	040	045	046	047	048	049	050
	30	024	041	060	067	070	072	074	075
3	50	014	027	044	054	059	064	066	068
	70	009	018	031	040	045	051	054	056
	90	007	014	025	033	039	043	046	047
	10	031	044	052	053	054	055	056	059
	30	018	033	051	059	064	067	068	071
4	50	009	018	031	039	045	050	052	055
	70	005	011	019	025	029	035	038	040
	90	004	008	015	020	024	028	031	032
	10	028	046	059	062	063	064	065	073
	30	010	020	034	043	048	052	054	061
6	50	004	009	016	021	024	029	031	035
	70	003	005	010	013	015	018	020	023
	90	002	004	007	010	012	014	016	018
	10	024	043	059	064	066	067	067	083
	30	006	012	022	028	032	037	039	048
8	50	002	005	009	012	015	018	020	024
	70	002	003	006	008	009	011	013	016
	90	001	003	005	006	007	009	010	013
	10	020	037	054	061	064	065	066	089
	30	004	008	014	019	022	026	029	039
10	50	001	003	006	008	010	012	014	019
	70	001	002	004	006	007	008	009	012
	90	001	002	004	005	006	007	007	010

ILLUMINANCE FROM SKY -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 30

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	008	010	013	014	015	019	021	021
	30	013	019	022	023	024	026	027	027
1	50	014	022	029	031	031	033	034	034
	70	013	023	032	035	036	037	038	038
	90	013	023	034	038	040	039	040	040
	10	011	014	015	016	017	018	019	019
	30	012	020	026	029	029	031	031	032
2	50	009	017	025	029	031	033	033	034
	70	007	013	022	027	029	032	032	033
	90	006	012	021	027	030	031	032	032
	10	012	017	019	019	020	021	021	022
	30	010	017	025	028	029	030	031	032
3	50	006	011	019	023	025	027	028	029
	70	004	008	014	018	020	023	025	025
	90	003	007	012	016	019	021	023	023
	10	013	018	022	022	023	023	024	025
	30	007	014	021	025	026	028	028	030
4	50	004	008	014	017	019	022	023	024
	70	003	005	009	012	014	017	018	019
	90	002	004	008	010	012	014	016	017
	10	012	019	024	026	026	027	027	030
	30	004	009	014	018	020	022	023	026
6	50	002	004	008	010	012	014	015	017
	70	001	003	005	006	008	009	010	012
	90	001	002	004	005	006	007	008	009
	10	010	017	024	026	027	028	028	034
	30	003	006	010	013	015	017	018	022
8	50	001	003	005	006	007	009	010	013
	70	001	002	003	004	005	006	007	008
	90	001	001	002	003	004	005	005	006
	10	008	015	022	025	026	027	027	037
	30	002	004	007	009	011	013	014	019
10	50	001	002	003	004	005	006	007	010
	70	000	001	002	003	003	004	005	006
	90	000	001	002	002	003	003	004	005

ILLUMINANCE FROM SKY -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 45

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	002	003	003	004	004	005	006	006
	30	003	005	005	006	006	007	007	007
1	50	003	005	007	007	008	008	008	008
	70	003	005	008	008	009	009	009	009
	90	003	006	008	009	010	009	010	010
	10	003	003	004	004	004	005	005	005
	30	003	005	006	007	007	008	008	008
2	50	002	004	006	007	007	008	008	008
	70	002	003	005	006	007	008	008	008
	90	001	003	005	006	007	008	008	008
	10	003	004	005	005	005	005	005	006
	30	002	004	006	007	007	007	008	008
3	50	001	003	005	005	006	007	007	007
	70	001	002	003	004	005	006	006	006
	90	001	002	003	004	005	006	006	006
	10	003	004	005	005	006	006	006	006
	30	002	003	005	006	006	007	007	007
4	50	001	002	003	004	005	005	006	006
	70	001	001	002	003	004	004	005	005
	90	001	001	002	003	003	004	005	005
	10	003	005	006	006	006	006	007	007
	30	001	002	004	004	005	005	006	006
6	50	001	001	002	003	003	004	004	004
	70	000	001	001	002	002	003	003	003
	90	000	001	001	002	002	002	003	003
	10	002	004	006	006	007	007	007	008
	30	001	001	002	003	004	004	004	005
8	50	000	001	001	002	002	003	003	004
	70	000	000	001	001	001	002	002	003
	90	000	000	001	001	001	001	002	002
	10	002	004	005	006	006	006	007	009
	30	000	001	002	002	003	003	004	005
10	50	000	000	001	001	002	002	002	003
	70	000	000	001	001	001	001	001	002
	90	000	000	001	001	001	001	001	002

ILLUMINANCE FROM SKY -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 60

ROOM DEPTH / WINDOW HEIGHT		WINDOW WIDTH / WINDOW HEIGHT							W / H
D / H	% D	.5	1	2	3	4	6	8	INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
2	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
3	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

ILLUMINANCE FROM SKY -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 75

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
1	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
2	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
3	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

ILLUMINANCE FROM SKY -- THRU COMPONENT
VERTICAL BLINDS, ANGLE = 0

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	109	065	038	028	022	015	012	012
	30	199	145	088	062	048	032	024	024
1	50	171	174	118	085	065	044	033	033
	70	130	172	132	098	076	049	037	037
	90	109	162	143	106	083	051	039	039
	10	169	107	060	043	033	023	018	018
	30	142	164	113	083	065	045	034	034
2	50	073	110	107	084	068	048	036	037
	70	041	069	086	075	063	045	035	035
	90	029	052	074	072	062	042	033	033
	10	196	138	080	056	043	030	023	023
	30	086	123	108	083	066	046	035	036
3	50	035	058	074	066	055	041	032	033
	70	019	032	046	049	044	034	028	028
	90	013	023	035	040	041	031	025	026
	10	188	155	094	066	051	035	027	028
	30	052	082	092	074	060	043	033	035
4	50	019	033	047	049	043	033	027	028
	70	010	018	027	031	031	026	022	023
	90	008	013	020	024	026	023	020	021
	10	145	164	110	079	061	041	031	035
	30	024	041	055	054	046	034	027	030
6	50	009	016	023	026	026	023	019	021
	70	006	010	013	015	016	016	014	016
	90	005	008	010	011	012	013	012	014
	10	101	139	109	081	063	043	033	040
	30	012	022	033	036	034	027	022	026
8	50	005	009	013	015	016	016	014	017
	70	003	006	008	009	010	010	010	012
	90	003	005	007	007	008	008	008	010
	10	071	107	101	077	061	042	032	044
	30	007	014	021	024	025	021	017	024
10	50	003	006	009	010	011	011	010	014
	70	002	004	006	007	007	007	007	009
	90	002	004	005	005	006	006	006	007

ILLUMINANCE FROM SKY -- THRU COMPONENT
VERTICAL BLINDS, ANGLE = 15

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	114	069	043	032	026	019	015	015
	30	192	150	092	066	051	035	026	027
1	50	155	177	122	089	069	046	035	035
	70	113	161	137	102	079	052	039	039
	90	092	148	148	110	087	054	041	041
	10	174	111	063	045	036	025	020	020
	30	126	158	117	086	067	047	036	036
2	50	060	100	109	087	070	050	038	038
	70	033	060	081	077	065	047	036	036
	90	023	045	068	070	064	043	034	034
	10	190	142	083	058	045	031	024	025
	30	072	113	112	086	068	048	037	038
3	50	028	050	069	067	057	042	033	034
	70	015	027	042	046	044	036	029	029
	90	011	019	032	037	039	032	026	027
	10	173	160	098	069	053	037	028	030
	30	042	073	089	076	062	045	034	036
4	50	015	028	043	046	044	034	027	029
	70	008	015	024	028	029	027	022	023
	90	006	011	018	022	024	022	020	021
	10	129	159	114	081	063	043	033	037
	30	019	035	051	052	047	035	028	031
6	50	007	013	020	024	025	023	019	022
	70	005	009	012	014	015	015	014	016
	90	004	007	009	010	011	012	012	013
	10	087	128	113	084	065	045	034	042
	30	009	019	029	033	033	028	022	027
8	50	004	008	011	014	015	015	014	017
	70	003	006	007	009	009	010	009	011
	90	002	005	006	007	007	007	007	009
	10	058	097	103	080	063	044	033	045
	30	005	011	019	022	023	022	018	025
10	50	002	005	008	009	010	011	010	014
	70	002	004	006	006	006	007	007	009
	90	002	003	005	005	005	005	005	007

ILLUMINANCE FROM SKY -- THRU COMPONENT
VERTICAL BLINDS, ANGLE = 30

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	125	076	050	039	032	024	020	020
	30	166	164	102	074	058	040	031	031
1	50	104	166	135	099	077	052	040	040
	70	072	130	148	114	089	058	044	044
	90	057	106	146	123	097	061	046	046
	10	183	122	070	051	040	029	023	023
	30	081	137	129	095	075	052	040	041
2	50	038	068	102	096	078	055	043	043
	70	021	039	066	075	071	052	040	041
	90	015	029	050	061	064	048	038	038
	10	165	158	092	065	050	036	028	029
	30	045	080	111	095	076	053	041	042
3	50	018	033	055	063	061	047	037	038
	70	010	018	030	038	041	039	032	032
	90	007	013	022	028	033	032	029	030
	10	131	168	108	076	059	041	032	033
	30	026	048	077	080	069	049	038	040
4	50	010	018	030	039	042	038	030	032
	70	006	010	017	021	025	026	024	026
	90	004	008	013	016	018	020	020	021
	10	083	139	126	090	070	048	037	041
	30	012	023	037	046	047	039	031	035
6	50	005	010	014	018	020	022	021	023
	70	003	007	009	010	011	013	014	015
	90	003	006	007	008	009	010	010	012
	10	054	097	118	093	072	050	038	047
	30	006	012	020	026	029	029	024	030
8	50	002	006	008	010	011	013	013	017
	70	002	004	006	007	007	008	008	010
	90	002	004	005	006	006	006	006	008
	10	036	066	097	088	070	049	037	050
	30	003	007	013	016	019	021	019	026
10	50	001	003	006	007	008	009	009	012
	70	001	003	005	005	005	005	005	007
	90	001	002	004	004	004	004	004	006

ILLUMINANCE FROM SKY -- THRU COMPONENT
VERTICAL BLINDS, ANGLE = 45

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	150	088	058	048	041	033	027	027
	30	106	176	121	089	071	050	039	039
1	50	054	122	157	119	094	065	049	050
	70	035	077	142	135	109	072	055	055
	90	027	058	118	133	118	074	057	057
	10	162	147	083	060	049	036	029	029
	30	040	088	140	114	090	064	049	050
2	50	018	037	076	096	091	067	052	052
	70	010	020	041	060	068	062	049	049
	90	008	015	029	042	053	053	046	046
	10	107	172	110	077	060	043	034	035
	30	022	044	090	102	091	064	050	051
3	50	009	017	033	048	057	055	044	045
	70	005	010	018	024	031	038	037	037
	90	004	008	013	017	022	027	029	030
	10	072	149	131	092	071	050	038	040
	30	012	025	051	071	074	059	046	048
4	50	005	010	018	025	032	038	036	037
	70	003	006	010	014	016	022	024	025
	90	002	005	008	010	012	015	017	018
	10	041	090	137	109	084	058	044	050
	30	006	012	022	031	039	042	037	041
6	50	002	006	009	011	013	017	020	022
	70	002	004	006	007	008	009	011	012
	90	002	004	005	006	006	007	008	009
	10	025	054	105	108	088	060	046	056
	30	003	006	012	016	020	026	027	033
8	50	001	003	006	007	008	009	011	013
	70	001	003	004	005	005	006	006	008
	90	001	002	004	004	004	005	005	006
	10	016	034	072	089	083	059	045	061
	30	001	004	007	010	012	016	018	025
10	50	001	002	004	005	005	006	007	009
	70	001	002	004	004	004	004	004	006
	90	000	001	003	003	004	004	003	005

ILLUMINANCE FROM SKY -- THRU COMPONENT
VERTICAL BLINDS, ANGLE = 60

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	176	117	072	061	055	047	040	041
	30	048	128	161	119	096	070	055	055
1	50	020	059	142	153	127	090	070	070
	70	011	034	089	132	137	101	077	078
	90	008	024	063	100	123	104	080	080
	10	090	173	113	080	064	049	040	040
	30	014	041	103	133	122	087	068	068
2	50	005	015	039	064	084	088	071	072
	70	003	008	020	033	045	062	063	063
	90	003	006	014	022	030	041	049	049
	10	049	127	152	106	082	059	047	048
	30	006	019	047	076	094	088	068	070
3	50	002	007	016	026	035	052	054	056
	70	002	005	009	014	018	026	033	034
	90	001	004	007	010	013	017	021	022
	10	029	083	155	127	098	068	053	055
	30	003	010	025	041	056	070	063	066
4	50	001	004	009	014	018	027	03[illegible]	036
	70	001	003	006	008	010	014	017	018
	90	001	003	005	006	008	010	012	012
	10	013	042	102	129	117	080	061	069
	30	001	004	011	016	022	032	039	044
6	50	001	002	005	007	008	011	013	015
	70	001	002	005	005	006	007	008	009
	90	000	002	004	005	005	005	006	006
	10	006	022	059	093	104	084	064	079
	30	000	002	006	009	011	016	021	025
8	50	000	001	003	005	005	006	007	009
	70	000	001	003	004	004	005	005	006
	90	000	001	003	004	004	004	004	005
	10	003	012	035	059	077	079	063	085
	30	000	001	003	005	007	009	012	016
10	50	000	001	002	003	004	004	005	006
	70	000	001	002	003	003	003	003	005
	90	000	001	002	003	003	003	003	004

ILLUMINANCE FROM SKY -- THRU COMPONENT
VERTICAL BLINDS, ANGLE = 75

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	082	175	118	090	078	073	068	068
	30	009	041	119	169	161	121	099	099
1	50	002	014	053	094	133	151	126	126
	70	002	007	029	055	079	122	130	130
	90	002	004	019	037	054	083	107	107
	10	023	081	170	145	113	083	067	068
	30	001	009	035	064	093	129	121	122
2	50	001	003	011	023	035	058	078	079
	70	001	003	006	012	018	030	040	040
	90	001	002	005	008	012	019	025	026
	10	008	041	115	161	151	106	083	085
	30	000	003	014	027	041	068	089	092
3	50	000	002	006	009	014	023	032	033
	70	000	002	004	006	008	013	017	018
	90	000	001	004	005	007	009	012	012
	10	003	022	073	124	149	126	097	102
	30	000	001	007	014	021	036	050	052
4	50	000	001	004	006	008	012	017	017
	70	000	001	003	005	006	008	010	010
	90	000	001	003	004	005	006	008	008
	10	000	007	033	061	089	123	114	128
	30	000	001	003	006	009	013	019	021
6	50	000	000	002	004	005	006	007	008
	70	000	000	002	004	004	005	006	006
	90	000	000	002	003	004	004	005	005
	10	000	002	016	032	049	082	098	121
	30	000	000	001	003	004	007	009	011
8	50	000	000	001	002	003	004	005	006
	70	000	000	001	002	003	004	004	005
	90	000	000	001	002	003	004	004	005
	10	000	001	007	018	028	050	070	095
	30	000	000	001	001	002	004	006	008
10	50	000	000	000	001	002	003	003	005
	70	000	000	000	001	002	003	003	004
	90	000	000	000	001	002	003	003	004

ILLUMINANCE FROM GROUND -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 0

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	013	023	036	043	046	053	054	054
	30	017	029	043	051	054	062	063	063
1	50	018	033	049	056	060	070	070	071
	70	018	034	050	058	061	076	076	077
	90	016	030	044	053	056	080	081	081
	10	013	022	034	041	045	051	052	052
	30	015	029	045	054	059	063	065	066
2	50	014	030	050	060	066	070	072	073
	70	012	028	049	060	067	072	074	075
	90	010	024	042	052	058	071	073	074
	10	014	023	035	041	045	050	057	058
	30	013	027	044	053	059	063	070	072
3	50	010	023	042	052	059	063	067	068
	70	008	019	035	045	051	056	059	060
	90	007	015	028	036	042	050	055	056
	10	014	024	037	043	047	052	057	059
	30	010	024	042	052	057	061	065	068
4	50	007	017	033	042	047	053	055	058
	70	006	013	024	031	036	040	044	046
	90	005	011	019	025	028	033	037	039
	10	015	029	041	048	053	056	061	068
	30	007	018	032	041	047	052	055	061
6	50	004	010	019	024	028	033	036	041
	70	004	008	012	015	018	021	024	027
	90	003	007	010	013	015	017	020	022
	10	012	028	043	052	057	062	063	077
	30	005	012	023	030	035	041	043	053
8	50	003	007	012	015	018	021	023	028
	70	002	005	008	010	011	013	014	018
	90	002	005	007	009	009	011	012	015
	10	010	025	047	052	058	064	066	089
	30	003	008	018	022	026	031	033	045
10	50	002	005	008	010	012	014	016	021
	70	002	004	006	007	008	009	010	013
	90	002	004	006	006	007	008	009	012

ILLUMINANCE FROM GROUND -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 15

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	022	040	063	076	084	100	106	107
	30	025	045	068	080	086	099	101	102
1	50	027	050	075	086	092	106	107	108
	70	026	050	075	087	092	111	113	113
	90	023	044	066	078	083	115	116	116
	10	020	035	053	064	072	081	085	086
	30	021	043	067	079	087	093	095	096
2	50	019	043	072	086	095	098	100	101
	70	017	039	068	083	092	096	099	100
	90	014	032	056	069	077	091	094	095
	10	022	035	053	062	069	078	091	093
	30	018	039	064	077	084	090	104	107
3	50	014	032	057	071	080	085	093	096
	70	011	025	045	057	065	071	076	078
	90	009	020	035	044	051	059	066	068
	10	020	036	055	065	070	078	087	092
	30	014	034	059	072	079	085	092	097
4	50	010	023	043	054	061	068	072	075
	70	008	016	029	038	043	049	053	056
	90	007	013	023	029	033	038	042	045
	10	022	044	062	072	078	084	092	104
	30	010	024	043	055	062	069	074	083
6	50	006	013	023	029	034	040	044	050
	70	005	010	015	018	021	024	027	031
	90	005	009	013	015	017	019	022	024
	10	017	041	065	078	086	093	095	117
	30	006	016	030	039	045	052	055	068
8	50	004	008	014	018	020	024	026	032
	70	003	007	010	012	013	015	016	020
	90	003	006	009	010	011	012	013	016
	10	013	036	069	078	086	096	098	134
	30	004	010	022	028	032	038	041	056
10	50	002	006	010	012	014	016	017	024
	70	002	005	008	008	009	010	011	015
	90	002	005	007	008	008	009	010	013

ILLUMINANCE FROM GROUND -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 30

ROOM DEPTH / WINDOW HEIGHT		WINDOW WIDTH / WINDOW HEIGHT W / H							
D / H	% D	.5	1	2	3	4	6	8	INF
	10	030	053	084	104	116	140	152	152
	30	031	056	084	100	108	124	128	129
1	50	032	060	090	106	113	127	130	130
	70	031	059	089	105	111	129	131	132
	90	027	052	078	093	099	128	130	131
	10	025	043	066	080	089	105	111	112
	30	025	050	078	092	099	112	114	116
2	50	022	048	079	095	103	110	112	114
	70	018	041	070	086	095	100	103	104
	90	015	033	056	069	077	089	092	093
	10	026	043	064	076	084	098	117	121
	30	021	044	072	087	094	103	127	131
3	50	015	034	059	073	081	087	106	109
	70	012	024	043	054	061	067	077	079
	90	010	019	032	040	046	053	062	063
	10	024	044	066	078	084	096	113	119
	30	016	037	063	077	085	092	108	114
4	50	010	023	041	052	058	065	072	075
	70	008	016	027	033	038	043	048	051
	90	007	013	021	025	029	033	037	039
	10	025	053	077	091	098	105	116	131
	30	010	026	044	056	063	070	079	089
6	50	006	013	021	026	030	035	039	044
	70	005	010	014	017	018	021	024	027
	90	005	009	013	014	015	017	019	022
	10	019	047	078	095	105	114	116	144
	30	006	016	029	038	044	050	053	065
8	50	004	008	013	016	018	021	022	028
	70	003	007	010	011	012	013	014	017
	90	003	007	009	010	011	012	012	015
	10	013	037	074	085	095	106	109	148
	30	003	010	020	025	029	034	036	050
10	50	002	005	009	010	012	013	014	020
	70	002	005	007	008	008	009	010	013
	90	002	005	007	007	008	008	009	012

ILLUMINANCE FROM GROUND -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 45

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	034	060	094	114	127	176	194	195
	30	033	059	089	103	112	147	153	154
1	50	033	061	092	106	113	146	150	151
	70	031	059	090	103	110	144	147	147
	90	028	053	080	093	098	138	141	141
	10	027	047	071	084	096	127	134	135
	30	026	051	078	090	099	126	129	131
2	50	021	045	073	086	093	114	117	118
	70	017	036	060	072	080	094	096	097
	90	014	029	046	056	063	077	080	080
	10	026	046	068	079	092	116	118	121
	30	020	042	068	081	089	110	123	126
3	50	014	029	050	060	068	080	097	100
	70	011	021	034	041	047	055	064	066
	90	009	017	025	031	035	042	048	049
	10	025	049	075	087	093	112	120	126
	30	016	035	059	070	077	091	107	113
4	50	010	020	034	041	046	054	061	064
	70	008	014	022	026	029	033	038	040
	90	007	012	017	020	022	026	029	030
	10	023	054	083	100	109	116	113	128
	30	009	023	040	050	056	061	070	078
6	50	005	011	017	021	023	027	029	033
	70	004	009	012	013	015	016	017	020
	90	004	008	011	012	013	014	015	017
	10	015	041	071	088	098	106	109	134
	30	005	013	023	030	035	039	041	051
8	50	003	006	010	012	013	015	016	020
	70	002	005	007	008	009	010	010	013
	90	002	005	007	008	008	009	009	012
	10	010	028	058	067	075	083	086	117
	30	002	007	014	017	020	024	025	034
10	50	002	004	006	007	008	009	009	013
	70	001	003	005	005	006	006	006	009
	90	001	003	005	005	006	006	006	008

ILLUMINANCE FROM GROUND -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 60

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	034	057	086	110	121	165	183	184
	30	031	054	078	095	102	132	139	139
1	50	030	053	078	093	098	129	133	134
	70	027	050	074	087	092	125	128	128
	90	024	044	065	077	082	117	120	120
	10	026	045	064	080	103	114	121	122
	30	023	043	064	077	097	110	112	114
2	50	018	035	054	065	080	094	096	097
	70	014	026	041	050	061	071	073	074
	90	012	021	031	038	047	055	056	057
	10	027	049	072	083	099	103	069	071
	30	020	038	059	069	083	092	071	073
3	50	013	024	037	043	052	059	054	056
	70	010	017	024	028	033	037	034	035
	90	009	014	019	021	025	027	024	025
	10	025	050	078	091	097	100	078	082
	30	015	031	051	060	065	072	067	071
4	50	008	016	025	030	032	036	035	037
	70	007	012	016	018	020	021	020	021
	90	006	010	014	015	016	016	015	016
	10	015	037	059	072	079	084	066	074
	30	006	015	025	031	035	038	038	043
6	50	003	007	010	012	013	015	014	016
	70	003	005	007	008	008	009	008	009
	90	003	005	007	007	008	008	007	008
	10	008	022	039	048	054	058	060	074
	30	002	006	012	015	017	019	020	025
8	50	001	003	005	005	006	007	007	009
	70	001	003	004	004	004	004	005	006
	90	001	003	004	004	004	004	004	005
	10	004	013	028	032	036	041	042	057
	30	001	003	006	008	009	010	011	015
10	50	001	002	003	003	003	004	004	005
	70	001	001	002	002	002	003	003	004
	90	001	001	002	002	002	003	003	004

ILLUMINANCE FROM GROUND -- THRU COMPONENT
HORIZONTAL BLINDS, ANGLE = 75

ROOM DEPTH / WINDOW HEIGHT D / H	% D	.5	1	2	3	4	6	8	INF
		WINDOW WIDTH / WINDOW HEIGHT W / H							
	10	027	041	073	088	097	057	064	064
	30	023	037	062	074	079	045	048	048
1	50	021	034	058	069	073	043	045	045
	70	019	030	052	062	066	042	043	043
	90	017	027	045	054	057	038	039	039
	10	023	040	058	065	056	039	042	042
	30	019	034	049	056	050	037	038	038
2	50	014	024	035	040	038	031	031	032
	70	011	018	024	028	026	022	023	023
	90	010	014	019	021	019	016	016	017
	10	016	030	045	052	046	035	018	019
	30	011	021	032	038	036	030	018	019
3	50	007	012	017	020	020	018	013	014
	70	005	008	011	012	012	010	008	008
	90	005	007	009	010	009	007	005	005
	10	010	021	033	039	042	034	022	023
	30	006	012	019	023	024	023	018	019
4	50	003	006	008	010	010	010	008	009
	70	003	004	005	006	006	005	004	005
	90	002	004	005	005	005	005	003	004
	10	004	010	018	022	024	025	017	019
	30	001	004	007	008	009	010	009	010
6	50	001	002	002	003	003	003	003	003
	70	001	001	002	002	002	002	002	002
	90	001	001	002	002	002	002	002	002
	10	002	005	009	012	013	014	015	018
	30	000	001	002	003	003	004	004	005
8	50	000	001	001	001	001	001	001	002
	70	000	001	001	001	001	001	001	001
	90	000	001	001	001	001	001	001	001
	10	001	002	005	006	007	008	008	011
	30	000	000	001	001	001	002	002	002
10	50	000	000	000	000	000	001	001	001
	70	000	000	000	000	000	000	000	001
	90	000	000	000	000	000	000	000	001

ILLUMINANCE FROM GROUND -- THRU COMPONENT
VERTICAL BLINDS, ANGLE = 0

ROOM DEPTH / WINDOW HEIGHT D / H	% D	.5	1	2	3	4	6	8	INF
		WINDOW WIDTH / WINDOW HEIGHT							W / H
	10	028	031	028	024	019	015	011	011
	30	035	038	034	028	023	017	013	013
1	50	038	043	038	031	025	019	014	014
	70	037	044	039	032	026	020	015	015
	90	033	039	034	028	023	021	016	016
	10	028	031	029	025	022	016	013	013
	30	031	039	038	033	028	021	016	016
2	50	027	040	042	037	032	023	018	018
	70	023	036	041	038	033	024	019	019
	90	019	029	034	032	028	024	019	019
	10	032	032	030	026	022	017	015	015
	30	028	036	038	034	029	022	018	019
3	50	020	030	035	033	030	022	018	019
	70	015	023	029	029	028	021	017	018
	90	013	018	023	024	023	020	017	017
	10	032	034	032	027	023	018	015	015
	30	022	032	036	033	029	022	018	018
4	50	014	022	028	027	025	020	016	017
	70	010	015	020	021	021	017	014	015
	90	009	013	016	017	017	015	013	014
	10	026	041	036	031	026	019	016	018
	30	012	024	027	027	025	020	016	018
6	50	007	012	015	016	016	014	012	014
	70	006	009	010	011	011	010	010	011
	90	005	008	008	009	009	009	009	010
	10	020	039	037	033	028	021	017	020
	30	007	015	020	020	020	017	014	017
8	50	004	008	009	010	011	010	009	011
	70	004	006	006	007	007	007	006	008
	90	003	006	006	006	006	006	006	007
	10	015	033	043	033	029	022	017	023
	30	004	010	016	015	014	014	012	016
10	50	003	005	007	007	007	007	007	009
	70	002	004	005	005	005	005	004	006
	90	002	004	005	004	004	004	004	005

ILLUMINANCE FROM GROUND -- THRU COMPONENT
VERTICAL BLINDS, ANGLE = 15

ROOM DEPTH / WINDOW HEIGHT		WINDOW WIDTH / WINDOW HEIGHT							W / H
D / H	% D	.5	1	2	3	4	6	8	INF
	10	031	035	034	029	025	020	016	016
	30	035	040	037	031	026	020	015	015
1	50	037	044	041	034	028	021	016	016
	70	035	044	041	034	028	022	017	017
	90	031	039	036	030	025	022	017	017
	10	028	032	031	028	025	019	015	015
	30	030	039	039	035	030	022	018	018
2	50	025	038	042	038	034	024	019	019
	70	021	034	040	038	034	025	020	020
	90	017	028	033	032	029	025	019	020
	10	031	033	031	027	024	019	016	017
	30	026	035	038	035	030	023	019	020
3	50	018	028	034	034	031	023	019	020
	70	013	021	028	029	028	022	018	019
	90	012	017	022	023	023	020	017	018
	10	030	034	033	029	025	019	016	017
	30	020	030	035	033	030	022	018	019
4	50	012	020	026	027	026	021	017	018
	70	009	014	019	020	020	017	015	016
	90	009	012	015	016	017	015	014	015
	10	024	040	036	032	027	020	017	019
	30	010	022	026	026	025	020	017	019
6	50	006	011	014	016	016	015	013	014
	70	005	008	009	010	010	010	010	011
	90	005	007	008	008	008	009	008	009
	10	018	037	037	034	029	022	017	021
	30	006	014	018	020	020	017	014	017
8	50	003	007	009	010	010	010	009	011
	70	003	006	006	006	006	006	006	008
	90	003	005	005	005	005	005	005	007
	10	013	030	043	033	029	023	018	024
	30	003	009	015	014	014	014	012	016
10	50	002	005	007	006	007	007	007	009
	70	002	004	005	004	004	004	004	006
	90	002	004	004	004	004	004	004	005

ILLUMINANCE FROM GROUND -- THRU COMPONENT
VERTICAL BLINDS, ANGLE = 30

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	030	037	040	037	032	027	022	022
	30	032	039	040	036	030	024	019	019
1	50	032	042	043	038	032	025	019	019
	70	030	041	043	038	032	025	020	020
	90	026	037	038	034	028	026	020	020
	10	026	031	033	031	028	023	019	019
	30	025	035	039	037	033	025	020	020
2	50	020	033	041	039	036	027	022	022
	70	016	028	037	038	036	028	022	022
	90	014	023	030	032	031	028	022	022
	10	028	031	032	029	027	022	019	020
	30	021	031	037	035	032	025	022	022
3	50	014	023	031	033	031	025	021	022
	70	011	017	024	026	027	023	020	020
	90	009	013	018	021	022	021	019	020
	10	026	031	033	030	027	021	018	019
	30	015	025	033	033	031	024	020	021
4	50	009	016	023	025	025	022	019	019
	70	007	011	016	018	018	017	016	017
	90	007	009	012	014	014	015	014	015
	10	017	036	035	033	029	022	019	021
	30	007	017	023	025	025	022	018	020
6	50	004	009	012	013	014	014	013	015
	70	003	007	007	008	009	009	009	011
	90	003	006	006	007	007	007	008	009
	10	012	029	035	034	031	024	019	024
	30	004	010	015	018	018	017	015	019
8	50	002	005	007	008	009	009	009	011
	70	002	004	005	005	005	005	006	007
	90	002	004	004	005	004	004	005	006
	10	008	022	041	032	030	025	020	027
	30	002	006	012	012	013	013	012	017
10	50	001	003	005	005	006	006	006	008
	70	001	003	004	004	004	004	004	005
	90	001	003	004	003	003	003	003	004

ILLUMINANCE FROM GROUND -- THRU COMPONENT
VERTICAL BLINDS, ANGLE = 45

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	027	036	045	045	042	037	031	032
	30	027	036	043	042	038	031	025	025
1	50	025	037	045	043	039	031	025	025
	70	023	036	044	043	038	032	025	025
	90	019	032	039	039	034	032	025	025
	10	024	029	034	034	033	029	025	025
	30	020	030	038	038	037	030	025	025
2	50	015	026	037	039	039	032	026	027
	70	012	021	032	035	037	032	027	027
	90	010	016	025	029	030	031	026	027
	10	023	028	032	032	030	026	024	025
	30	014	025	034	036	035	029	026	027
3	50	009	017	026	030	031	028	025	025
	70	007	012	018	022	024	024	022	023
	90	007	010	014	016	018	020	021	021
	10	018	029	034	033	030	025	022	024
	30	009	020	029	032	032	028	024	025
4	50	006	011	018	021	023	023	021	022
	70	005	008	012	014	015	016	016	017
	90	004	007	009	010	011	012	013	014
	10	009	025	033	035	033	026	022	025
	30	004	011	018	022	023	023	020	023
6	50	002	005	008	010	012	013	014	015
	70	002	004	006	006	007	008	008	009
	90	002	004	005	005	005	006	006	007
	10	006	018	033	033	035	028	023	028
	30	002	006	012	014	016	017	016	020
8	50	001	003	005	006	007	008	008	010
	70	001	003	004	004	004	004	005	006
	90	001	003	004	004	004	004	004	004
	10	004	012	031	031	030	028	023	032
	30	001	003	008	009	011	012	012	016
10	50	001	002	004	004	004	005	005	007
	70	001	002	003	003	003	003	003	004
	90	001	002	003	003	003	002	002	003

ILLUMINANCE FROM GROUND -- THRU COMPONENT
VERTICAL BLINDS, ANGLE = 60

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
1	10	023	032	046	053	054	053	047	047
	30	021	030	041	046	046	043	035	036
	50	018	030	042	047	047	043	035	035
	70	015	027	040	045	046	044	035	035
	90	013	024	035	041	041	044	035	035
2	10	021	026	033	036	038	038	034	034
	30	015	024	034	038	039	038	033	033
	50	010	018	030	035	038	037	034	034
	70	008	014	024	029	033	034	033	033
	90	007	011	018	023	026	031	031	031
3	10	014	026	033	034	035	033	032	033
	30	007	019	029	033	035	034	033	034
	50	004	012	019	024	028	029	029	030
	70	004	008	013	016	019	022	023	024
	90	003	007	010	012	014	017	019	020
4	10	009	024	035	036	035	032	029	031
	30	004	014	024	028	030	030	029	030
	50	002	008	013	016	019	021	022	023
	70	002	006	008	010	011	013	015	016
	90	002	005	007	008	008	010	011	012
6	10	003	013	033	039	039	033	030	033
	30	001	005	015	018	020	022	022	025
	50	001	003	006	007	009	010	012	014
	70	001	002	004	005	005	006	007	007
	90	001	002	004	004	004	005	005	005
8	10	002	007	026	034	040	036	030	037
	30	000	002	008	011	013	015	016	019
	50	000	001	003	004	005	006	006	008
	70	000	001	003	003	003	003	004	004
	90	000	001	003	003	003	003	003	004
10	10	001	004	016	028	031	036	031	042
	30	000	001	004	007	008	010	011	015
	50	000	001	002	003	003	003	004	005
	70	000	001	002	002	002	002	002	003
	90	000	001	002	002	002	002	002	003

ILLUMINANCE FROM GROUND -- THRU COMPONENT
VERTICAL BLINDS, ANGLE = 75

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
1	10	018	023	038	052	059	080	080	080
	30	015	020	033	044	048	063	059	060
	50	011	019	031	042	046	061	058	058
	70	009	016	029	038	043	060	057	057
	90	008	014	025	034	038	057	055	055
2	10	008	020	029	036	043	050	049	049
	30	005	016	026	033	040	048	045	046
	50	003	011	019	026	032	042	040	041
	70	003	008	014	019	024	032	033	033
	90	002	007	011	015	019	025	027	027
3	10	004	013	029	035	041	045	045	047
	30	002	009	021	027	033	041	046	048
	50	001	005	012	016	020	026	035	036
	70	001	004	008	010	013	016	022	022
	90	001	003	007	008	010	012	015	016
4	10	002	009	025	035	040	043	044	047
	30	001	005	015	022	026	032	038	040
	50	000	002	008	011	012	016	020	021
	70	000	002	005	007	007	009	011	012
	90	000	002	005	006	006	007	008	009
6	10	000	003	014	026	035	043	043	049
	30	000	001	006	011	015	019	024	027
	50	000	001	002	004	006	007	009	010
	70	000	000	002	003	004	004	005	005
	90	000	000	002	003	004	004	004	005
8	10	000	001	008	017	024	036	042	052
	30	000	000	002	005	008	012	013	017
	50	000	000	001	002	003	004	004	005
	70	000	000	001	002	002	003	003	004
	90	000	000	001	002	002	003	003	003
10	10	000	000	003	011	017	026	034	046
	30	000	000	001	002	004	007	008	011
	50	000	000	000	001	002	002	003	004
	70	000	000	000	001	001	002	002	003
	90	000	000	000	001	001	002	002	003

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
HORIZONTAL BLINDS, ANGLE = 0

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	685	813	1025	1230	1430	1802	2161	2167
	30	255	334	401	458	518	621	730	732
1	50	141	205	253	282	313	356	411	412
	70	090	139	180	199	218	234	265	266
	90	068	107	142	155	169	166	186	187
	10	359	447	552	647	738	914	1086	1097
	30	097	147	192	215	233	268	307	310
2	50	039	065	093	106	112	122	137	138
	70	022	036	054	062	066	069	077	078
	90	017	027	040	047	050	049	055	056
	10	228	307	379	439	494	602	702	720
	30	043	072	101	116	124	139	149	153
3	50	015	026	040	048	052	056	055	056
	70	010	016	025	031	034	036	033	034
	90	009	013	020	025	027	029	026	026
	10	155	225	283	324	362	435	503	528
	30	020	036	054	064	070	078	083	087
4	50	008	013	021	027	031	034	034	036
	70	006	010	015	019	022	025	024	025
	90	005	009	013	016	019	021	020	021
	10	077	128	173	196	215	252	287	322
	30	006	012	020	025	028	032	033	037
6	50	003	006	009	012	014	017	017	019
	70	002	005	008	010	011	014	014	016
	90	002	005	007	009	010	013	012	014
	10	042	075	108	124	135	155	174	214
	30	002	005	009	012	014	016	018	022
8	50	001	003	005	007	008	009	011	013
	70	001	003	004	006	007	008	010	012
	90	001	002	004	005	006	008	009	011
	10	024	044	068	079	086	097	108	147
	30	001	003	005	006	008	009	010	014
10	50	001	002	003	004	005	006	007	009
	70	001	001	003	004	004	005	006	008
	90	001	001	003	003	004	005	005	007

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
HORIZONTAL BLINDS, ANGLE = 15

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	711	849	1073	1289	1501	1891	2271	2277
	30	280	370	449	515	582	700	823	826
1	50	164	242	304	342	379	436	502	504
	70	112	177	233	261	286	313	355	356
	90	089	144	198	220	241	244	274	275
	10	381	477	589	691	789	977	1161	1173
	30	115	177	232	261	284	329	376	380
2	50	053	089	129	149	159	177	198	200
	70	032	055	084	100	107	117	130	131
	90	025	042	066	079	086	091	101	102
	10	249	336	415	480	541	660	768	788
	30	057	096	136	156	168	190	206	211
3	50	023	041	064	078	085	094	096	099
	70	015	026	041	052	057	064	063	065
	90	012	021	034	043	047	053	052	053
	10	175	254	319	365	408	490	567	594
	30	031	055	083	098	108	121	130	136
4	50	012	023	037	046	052	060	061	064
	70	009	015	025	032	037	043	044	046
	90	008	013	021	027	032	037	038	040
	10	094	156	209	236	259	303	344	387
	30	011	023	037	045	051	058	061	068
6	50	005	010	017	022	025	031	032	036
	70	004	008	013	017	019	024	025	028
	90	004	007	012	015	017	021	022	025
	10	056	099	141	161	175	201	226	278
	30	005	011	019	024	028	033	036	044
8	50	003	006	010	013	015	018	021	025
	70	002	005	008	010	012	015	017	021
	90	002	004	007	009	011	013	015	019
	10	035	064	098	113	123	139	155	210
	30	003	006	012	015	017	020	023	031
10	50	001	003	006	008	010	012	013	018
	70	001	003	006	007	008	010	011	015
	90	001	003	005	006	007	009	010	014

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
HORIZONTAL BLINDS, ANGLE = 30

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	735	883	1124	1352	1577	1998	2406	2414
	30	302	403	494	569	645	784	923	926
1	50	184	276	352	397	441	518	598	600
	70	131	210	282	318	350	395	449	451
	90	107	177	246	278	305	327	368	370
	10	399	502	623	732	836	1037	1233	1246
	30	130	203	268	303	331	384	440	445
2	50	065	111	163	189	204	229	256	259
	70	041	073	114	137	149	166	184	186
	90	033	059	094	114	126	138	153	154
	10	266	360	446	516	582	710	827	848
	30	069	117	166	192	208	236	256	263
3	50	030	056	088	107	118	133	139	142
	70	020	036	059	075	084	096	098	101
	90	017	030	049	062	070	081	083	085
	10	191	277	349	399	447	537	621	651
	30	039	072	109	129	142	160	173	181
4	50	017	032	054	067	077	088	093	098
	70	012	022	037	047	055	064	067	071
	90	010	019	031	040	046	055	058	061
	10	108	179	238	269	296	346	393	442
	30	016	033	055	067	075	086	092	103
6	50	008	016	026	034	039	047	050	056
	70	006	012	019	024	028	035	037	042
	90	005	011	017	021	025	031	033	037
	10	067	120	169	193	210	241	271	333
	30	008	018	031	039	045	052	057	071
8	50	004	009	015	020	023	028	032	039
	70	003	007	012	015	017	021	024	030
	90	003	007	011	014	016	019	022	027
	10	044	082	124	143	155	175	195	265
	30	004	010	019	025	029	034	038	051
10	50	002	006	010	013	015	018	021	028
	70	002	005	009	010	012	014	016	022
	90	002	005	008	010	011	013	015	020

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
HORIZONTAL BLINDS, ANGLE = 45

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	757	918	1177	1422	1664	2119	2562	2570
	30	321	434	539	624	709	868	1026	1029
1	50	202	307	397	452	504	598	693	695
	70	147	240	327	372	411	474	541	543
	90	122	205	289	330	363	407	459	461
	10	414	525	656	773	883	1098	1307	1321
	30	143	226	301	342	375	438	502	507
2	50	075	131	194	226	246	279	313	316
	70	049	090	143	172	189	213	236	239
	90	040	074	119	147	163	183	202	205
	10	280	381	474	550	621	759	882	905
	30	078	135	194	225	245	279	306	314
3	50	037	069	110	135	149	169	180	184
	70	025	046	077	097	109	126	131	135
	90	021	038	064	081	093	108	114	117
	10	203	297	376	431	483	581	671	705
	30	046	086	132	157	173	197	214	225
4	50	021	042	070	087	100	115	123	129
	70	015	028	048	061	071	084	090	094
	90	013	024	040	052	061	073	078	082
	10	120	199	265	300	330	386	438	493
	30	021	043	071	087	098	113	121	136
6	50	010	021	035	045	052	062	067	075
	70	008	016	025	032	037	045	049	055
	90	007	014	022	028	032	040	043	048
	10	076	137	194	222	242	278	313	385
	30	011	024	041	053	060	071	078	096
8	50	005	012	021	026	031	037	042	052
	70	005	010	016	020	023	028	032	039
	90	004	009	014	018	021	025	029	035
	10	050	097	148	170	186	210	234	318
	30	006	014	027	034	040	048	053	072
10	50	003	008	014	017	020	025	028	038
	70	003	007	011	014	016	019	021	029
	90	003	006	011	013	014	017	020	027

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
HORIZONTAL BLINDS, ANGLE = 60

ROOM DEPTH / WINDOW HEIGHT		WINDOW WIDTH / WINDOW HEIGHT							W / H
D / H	% D	.5	1	2	3	4	6	8	INF
	10	779	955	1235	1498	1758	2252	2735	2744
	30	339	465	585	681	777	958	1135	1138
1	50	219	337	442	507	568	681	791	794
	70	163	269	371	426	472	555	636	637
	90	136	230	328	380	420	485	550	551
	10	428	547	690	815	933	1165	1388	1404
	30	155	247	334	383	420	496	569	575
2	50	084	149	224	263	287	331	372	376
	70	057	105	168	204	225	258	287	290
	90	047	086	141	174	194	223	247	250
	10	292	400	503	585	662	812	942	967
	30	087	152	221	258	281	326	361	371
3	50	043	081	130	160	177	204	224	229
	70	029	055	091	116	130	153	163	167
	90	025	046	076	097	111	131	140	144
	10	214	315	403	464	520	629	728	765
	30	052	099	154	183	204	234	261	274
4	50	025	049	083	104	119	139	151	159
	70	018	034	057	073	085	101	110	115
	90	016	029	048	062	072	088	095	100
	10	129	218	292	333	368	432	487	549
	30	024	051	085	105	119	138	151	170
6	50	012	025	042	054	062	075	081	092
	70	010	019	031	038	044	054	058	066
	90	009	018	027	034	039	048	052	058
	10	083	152	218	252	276	318	358	442
	30	013	029	050	064	074	087	096	119
8	50	007	015	025	032	037	045	051	062
	70	006	012	019	024	027	033	038	046
	90	005	011	018	022	025	030	034	042
	10	055	108	167	193	212	242	269	367
	30	007	017	033	041	048	058	064	088
10	50	004	009	017	021	024	029	033	045
	70	003	008	014	016	019	022	025	034
	90	003	008	013	015	017	020	023	032

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
HORIZONTAL BLINDS, ANGLE = 75

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	808	1000	1306	1593	1875	2399	2926	2936
	30	362	503	641	754	862	1059	1258	1262
1	50	239	373	496	575	647	775	903	906
	70	181	301	420	489	545	644	741	743
	90	152	259	372	436	484	569	648	650
	10	446	577	734	874	1006	1244	1486	1502
	30	169	273	374	434	483	565	650	657
2	50	094	169	256	305	338	390	440	445
	70	065	121	193	236	264	304	340	343
	90	054	099	161	199	225	259	289	292
	10	308	427	545	638	723	878	989	1015
	30	097	172	254	299	330	382	405	415
3	50	049	093	151	186	208	240	257	264
	70	035	064	106	133	151	176	185	190
	90	030	054	087	111	127	150	156	160
	10	226	338	441	512	576	690	778	818
	30	059	113	178	215	240	277	303	318
4	50	029	057	096	121	138	161	173	182
	70	021	040	066	084	097	115	123	129
	90	019	034	056	071	082	099	106	111
	10	137	234	318	366	406	478	527	594
	30	027	058	097	120	137	159	174	195
6	50	014	029	047	060	070	084	090	102
	70	011	022	034	043	049	060	064	072
	90	010	020	031	038	043	053	057	064
	10	087	162	235	274	301	349	393	485
	30	014	032	056	072	083	098	108	133
8	50	007	016	027	035	040	049	055	068
	70	006	013	021	026	030	036	041	050
	90	006	013	019	024	027	033	037	046
	10	057	114	180	208	230	262	292	399
	30	008	019	036	045	053	064	071	096
10	50	004	010	018	022	026	031	036	048
	70	004	009	015	018	020	024	027	037
	90	004	008	014	016	019	022	025	034

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
VERTICAL BLINDS, ANGLE = 0

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	325	436	580	701	823	1017	1221	1225
	30	109	196	274	326	379	443	525	526
1	50	063	129	202	242	282	322	377	378
	70	046	095	162	199	233	266	310	311
	90	038	077	136	172	202	233	271	272
	10	151	238	333	402	459	560	668	675
	30	038	086	154	190	213	249	291	294
2	50	020	047	094	123	141	167	194	196
	70	015	033	064	088	103	125	145	147
	90	013	027	051	069	083	102	120	121
	10	082	161	238	293	332	403	451	463
	30	018	046	093	124	142	170	178	183
3	50	009	023	048	068	082	100	109	112
	70	008	017	032	045	054	069	075	076
	90	007	014	026	036	043	055	060	062
	10	048	115	184	228	265	320	359	377
	30	009	027	058	082	099	122	135	142
4	50	005	013	028	040	051	065	072	076
	70	004	010	019	027	033	043	048	051
	90	004	009	017	022	028	035	040	042
	10	020	061	119	152	178	219	243	273
	30	003	011	027	039	050	065	075	084
6	50	002	006	013	018	023	031	035	040
	70	002	005	010	013	016	021	024	027
	90	002	005	009	012	014	019	021	023
	10	010	033	079	106	125	155	180	221
	30	001	005	014	021	027	037	044	054
8	50	001	003	007	010	012	017	021	025
	70	001	003	006	008	010	012	015	019
	90	001	003	006	008	009	011	014	017
	10	005	019	053	075	090	112	130	177
	30	001	003	008	012	016	022	027	037
10	50	000	002	004	006	008	010	013	017
	70	000	002	004	005	006	008	010	013
	90	000	002	004	005	006	008	009	012

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
VERTICAL BLINDS, ANGLE = 15

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
1	10	374	477	621	745	873	1075	1294	1298
	30	158	238	311	360	413	478	564	565
	50	099	172	239	275	313	352	409	410
	70	075	135	199	232	263	294	338	339
	90	064	113	173	205	232	259	297	298
2	10	196	273	362	429	485	587	698	706
	30	066	122	183	215	236	269	311	315
	50	037	072	121	147	163	185	211	214
	70	027	050	087	110	123	141	161	162
	90	023	041	070	090	102	118	134	136
3	10	125	195	264	315	354	424	471	483
	30	036	071	118	145	161	186	193	198
	50	019	037	066	086	097	114	121	124
	70	014	026	045	059	068	080	085	087
	90	012	022	037	048	055	067	070	072
4	10	085	149	209	249	284	337	376	394
	30	021	044	079	100	116	135	147	154
	50	011	022	040	053	063	075	081	085
	70	008	016	027	035	043	052	056	058
	90	007	014	023	030	036	044	047	049
6	10	046	095	144	173	195	234	256	288
	30	009	021	039	052	062	075	083	093
	50	005	011	019	025	030	037	041	046
	70	004	009	014	018	021	026	028	032
	90	004	008	013	016	018	023	025	028
8	10	027	060	102	125	141	168	191	235
	30	004	011	021	029	036	044	050	062
	50	002	006	011	014	017	021	025	030
	70	002	005	008	011	012	015	018	022
	90	002	005	008	010	011	014	016	020
10	10	017	039	075	092	105	124	141	191
	30	002	006	013	018	022	028	032	044
	50	001	004	007	009	010	013	015	021
	70	001	003	006	007	008	010	012	016
	90	001	003	006	007	008	009	011	015

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
VERTICAL BLINDS, ANGLE = 30

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	427	524	667	794	927	1137	1372	1376
	30	209	284	350	396	449	514	604	606
1	50	146	219	279	310	347	384	442	444
	70	112	181	239	267	295	323	368	369
	90	095	157	212	239	263	287	324	325
	10	243	310	392	458	514	616	730	738
	30	101	159	214	243	261	291	333	336
2	50	057	102	149	172	185	204	229	232
	70	040	072	112	133	144	159	176	178
	90	033	059	093	112	122	135	149	151
	10	171	231	292	340	376	445	491	503
	30	058	101	144	168	181	203	208	213
3	50	029	055	086	104	114	127	133	136
	70	021	037	060	074	082	093	095	097
	90	018	031	049	062	069	079	080	082
	10	128	184	236	272	304	356	393	413
	30	035	066	101	119	132	149	159	167
4	50	017	033	054	066	075	086	090	095
	70	013	023	037	046	053	061	063	067
	90	011	020	031	039	045	052	055	057
	10	079	129	170	194	214	250	270	304
	30	016	033	054	066	074	085	091	103
6	50	008	016	026	033	037	044	047	053
	70	006	012	019	023	026	031	033	037
	90	006	011	017	020	023	028	030	033
	10	050	091	126	145	158	182	203	250
	30	008	018	031	039	045	052	057	070
8	50	004	009	015	019	022	026	029	035
	70	004	007	011	014	016	019	021	026
	90	003	007	010	013	014	017	019	024
	10	033	065	098	110	121	136	151	205
	30	004	011	020	025	029	034	037	050
10	50	003	006	010	012	014	017	019	025
	70	002	005	008	009	011	012	014	019
	90	002	005	008	009	010	012	013	018

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
VERTICAL BLINDS, ANGLE = 45

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	489	578	720	848	986	1204	1453	1458
	30	268	337	395	438	490	555	649	651
1	50	189	272	325	351	385	419	479	480
	70	147	230	286	307	332	356	400	402
	90	124	200	259	279	299	319	354	355
	10	299	353	428	491	546	648	765	773
	30	134	202	251	274	289	316	357	360
2	50	076	130	182	202	211	227	249	252
	70	052	093	139	159	168	179	195	197
	90	043	076	116	137	145	155	166	168
	10	223	273	324	368	402	469	514	527
	30	078	130	175	194	204	222	225	231
3	50	039	071	107	126	133	144	147	151
	70	027	048	075	091	098	107	107	110
	90	023	040	062	076	084	092	092	094
	10	171	226	267	298	328	377	412	433
	30	048	086	126	142	152	165	173	182
4	50	023	043	068	082	090	098	101	106
	70	017	029	046	056	063	071	072	076
	90	015	025	038	047	054	062	064	067
	10	108	169	201	219	235	268	286	322
	30	022	044	069	081	088	097	101	114
6	50	011	021	033	041	046	052	054	061
	70	009	016	023	028	032	037	039	043
	90	008	015	021	025	028	033	035	039
	10	070	122	155	169	178	198	217	268
	30	011	024	040	049	055	061	064	079
8	50	006	012	019	024	027	031	034	041
	70	005	010	014	017	019	022	025	030
	90	005	009	013	016	017	020	023	028
	10	046	088	125	132	139	151	163	222
	30	006	015	026	032	036	041	043	058
10	50	004	008	013	015	017	020	022	030
	70	003	007	010	012	013	015	016	022
	90	003	006	010	011	012	014	015	021

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
VERTICAL BLINDS, ANGLE = 60

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	576	649	787	916	1058	1281	1541	1546
	30	323	409	456	494	544	606	701	703
1	50	225	329	387	407	437	466	524	526
	70	174	274	346	363	383	401	442	444
	90	148	237	313	335	349	362	394	395
	10	371	414	476	536	588	689	807	816
	30	159	242	301	318	328	351	389	393
2	50	091	155	218	241	247	258	277	280
	70	063	110	165	190	200	208	220	222
	90	052	090	137	161	173	182	191	193
	10	272	334	369	407	438	502	544	558
	30	093	155	211	231	237	250	249	256
3	50	048	084	127	149	158	166	167	171
	70	033	057	088	106	116	125	124	128
	90	029	047	072	089	098	109	109	111
	10	206	279	312	336	362	406	440	462
	30	057	103	150	170	180	188	193	203
4	50	028	051	080	096	106	115	116	122
	70	021	035	054	066	074	083	085	089
	90	018	030	045	055	063	072	074	078
	10	129	206	244	255	267	294	309	348
	30	026	053	082	097	105	114	116	130
6	50	013	026	039	048	054	061	063	071
	70	010	019	027	033	037	043	045	050
	90	010	018	024	029	032	038	040	045
	10	083	147	191	202	207	221	238	293
	30	013	029	048	059	065	072	075	093
8	50	007	015	023	028	031	036	039	048
	70	006	012	017	020	022	026	028	035
	90	006	011	016	018	020	023	026	032
	10	055	105	154	161	166	172	182	248
	30	008	018	032	038	042	048	051	069
10	50	004	009	016	018	020	023	026	035
	70	004	008	013	014	015	017	019	025
	90	003	008	012	013	014	016	017	023

ILLUMINANCE FROM UNDERSIDE OF BLINDS (HIDDEN FROM SUN)
VERTICAL BLINDS, ANGLE = 75

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	731	782	902	1031	1176	1406	1672	1678
	30	371	494	569	599	645	703	795	797
1	50	254	382	476	510	537	560	611	613
	70	195	313	412	450	477	492	526	527
	90	165	269	367	406	432	451	475	476
	10	439	525	573	622	670	767	883	893
	30	179	279	363	395	407	422	454	459
2	50	102	175	253	287	302	318	335	338
	70	071	124	189	222	237	254	269	272
	90	059	102	156	187	202	219	232	235
	10	309	409	465	490	514	570	606	622
	30	102	176	247	279	293	308	302	310
3	50	053	096	146	174	187	202	206	211
	70	037	065	101	122	135	149	151	155
	90	032	054	083	101	113	127	129	133
	10	228	331	396	418	435	470	497	523
	30	062	116	174	201	217	232	237	248
4	50	031	058	092	111	124	137	141	148
	70	023	040	062	076	085	096	100	105
	90	020	035	052	063	072	083	087	091
	10	139	233	299	324	336	353	361	407
	30	027	059	094	113	124	137	142	160
6	50	014	029	045	055	062	071	075	084
	70	011	022	032	038	043	049	052	058
	90	011	020	029	034	037	044	046	052
	10	087	162	226	251	264	276	286	353
	30	014	032	055	068	076	086	091	112
8	50	007	016	026	032	036	042	046	056
	70	006	013	020	024	026	030	033	040
	90	006	013	018	022	023	027	030	036
	10	058	114	176	195	207	220	225	307
	30	008	019	035	043	049	057	061	082
10	50	004	010	018	021	024	027	030	040
	70	004	009	014	016	018	020	022	030
	90	004	008	014	015	017	018	020	027

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
HORIZONTAL BLINDS, ANGLE = 0

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	059	092	118	124	142	112	128	129
	30	062	099	127	135	155	128	146	147
1	50	057	095	126	137	156	137	157	158
	70	052	086	117	129	147	139	160	160
	90	046	075	102	114	130	135	155	155
	10	041	068	104	117	117	107	123	124
	30	036	065	101	117	122	120	138	140
2	50	027	050	080	094	101	106	122	123
	70	021	037	059	071	076	082	094	095
	90	019	030	046	054	058	064	073	073
	10	032	056	086	107	110	109	078	080
	30	022	044	072	090	097	106	090	092
3	50	014	027	044	055	061	068	069	071
	70	011	019	029	036	039	042	042	043
	90	010	016	023	028	030	031	029	030
	10	024	046	074	093	106	111	095	100
	30	014	029	050	064	074	084	087	091
4	50	008	015	025	032	037	042	044	046
	70	007	011	016	020	022	025	025	026
	90	006	010	014	016	018	020	019	020
	10	016	035	055	069	080	096	085	095
	30	006	014	024	031	037	045	049	055
6	50	003	007	010	012	014	017	018	020
	70	003	005	007	008	009	011	010	012
	90	003	005	007	007	008	010	009	010
	10	009	022	039	050	058	069	078	096
	30	002	006	012	016	019	023	026	032
8	50	001	003	005	006	007	008	009	011
	70	001	003	004	004	005	005	006	007
	90	001	003	004	004	005	005	006	007
	10	005	014	029	035	041	048	055	074
	30	001	003	006	008	010	012	014	019
10	50	001	002	003	003	003	004	004	006
	70	001	002	002	003	003	003	003	005
	90	001	002	002	003	003	003	003	005

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
HORIZONTAL BLINDS, ANGLE = 15

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	055	087	110	115	135	099	120	120
	30	054	086	109	114	132	098	115	115
1	50	048	080	105	111	128	101	117	118
	70	043	071	095	103	118	099	115	116
	90	039	062	083	090	104	094	108	109
	10	033	058	089	101	099	086	101	102
	30	028	052	082	094	096	090	104	106
2	50	021	038	061	071	075	076	088	089
	70	016	028	043	051	053	056	064	065
	90	014	022	033	039	040	041	047	048
	10	024	044	070	088	089	084	051	052
	30	016	032	054	068	073	077	056	057
3	50	010	019	030	038	042	046	042	043
	70	008	013	019	024	025	027	024	024
	90	008	011	016	019	019	020	016	016
	10	017	035	058	073	084	084	065	068
	30	010	020	035	045	052	059	057	060
4	50	006	010	016	020	024	026	026	027
	70	005	008	010	012	014	015	014	014
	90	004	007	009	011	012	012	011	011
	10	009	021	037	047	055	067	053	059
	30	003	008	014	019	022	027	028	032
6	50	002	004	005	006	007	009	009	010
	70	002	003	004	005	005	006	005	006
	90	002	003	004	004	005	006	005	006
	10	004	011	021	029	033	041	046	057
	30	001	003	006	008	009	011	013	016
8	50	001	001	002	003	003	004	004	005
	70	001	001	002	002	002	003	003	004
	90	001	001	002	002	002	003	003	004
	10	002	006	013	016	018	022	025	034
	30	000	001	002	003	004	005	005	007
10	50	000	001	001	001	001	001	002	002
	70	000	001	001	001	001	001	001	002
	90	000	001	001	001	001	001	001	002

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
HORIZONTAL BLINDS, ANGLE = 30

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	045	072	089	090	108	066	082	083
	30	041	067	083	083	097	059	071	071
1	50	037	061	077	079	091	060	070	070
	70	032	053	069	071	082	058	068	068
	90	029	046	060	062	072	054	063	063
	10	024	043	067	074	071	052	062	063
	30	020	036	058	066	065	052	061	062
2	50	014	025	041	047	048	043	050	051
	70	011	018	029	033	033	031	036	036
	90	010	015	022	025	025	022	026	026
	10	015	030	049	062	060	049	018	018
	30	011	021	035	044	046	044	019	019
3	50	007	011	018	024	025	025	014	014
	70	005	008	012	015	015	014	008	008
	90	005	007	010	012	012	010	005	005
	10	010	021	037	047	055	049	027	029
	30	006	012	021	027	032	033	023	024
4	50	003	006	009	011	013	013	010	011
	70	003	004	006	007	008	008	005	006
	90	003	004	006	007	007	007	004	004
	10	003	009	017	022	026	032	018	020
	30	001	003	006	008	010	012	009	011
6	50	001	001	002	003	003	004	003	003
	70	001	001	002	002	002	003	002	002
	90	001	001	002	002	002	003	002	002
	10	001	003	006	008	010	012	014	017
	30	000	001	002	002	003	003	004	005
8	50	000	000	001	001	001	001	001	001
	70	000	000	000	001	001	001	001	001
	90	000	000	000	001	001	001	001	001
	10	000	001	002	003	003	004	005	006
	30	000	000	000	001	001	001	001	001
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
HORIZONTAL BLINDS, ANGLE = 45

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	031	051	060	057	069	021	026	026
	30	027	045	052	050	058	017	021	021
1	50	024	040	048	046	054	017	020	020
	70	021	034	042	041	048	016	019	019
	90	019	030	036	035	042	015	018	018
	10	014	025	041	044	037	015	018	018
	30	011	021	034	038	033	015	017	017
2	50	008	014	023	026	024	012	014	014
	70	006	010	016	018	016	008	010	010
	90	006	009	013	014	012	006	007	007
	10	008	015	026	034	028	014	001	001
	30	005	010	018	023	021	012	001	001
3	50	003	006	009	012	011	007	001	001
	70	003	004	006	008	007	004	001	001
	90	002	004	005	006	005	003	000	000
	10	004	008	015	020	023	014	003	003
	30	002	004	008	011	013	009	003	003
4	50	001	002	003	005	005	004	001	001
	70	001	002	002	003	003	002	001	001
	90	001	002	002	003	003	002	001	001
	10	000	001	003	004	004	005	001	001
	30	000	001	001	001	002	002	001	001
6	50	000	000	000	000	001	001	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	001	001
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
HORIZONTAL BLINDS, ANGLE = 60

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT .5	1	2	3	4	6	8	W / H INF
	10	015	026	028	019	023	000	000	000
	30	013	022	023	016	019	000	000	000
1	50	012	020	021	015	017	000	000	000
	70	010	017	018	013	015	000	000	000
	90	009	015	016	011	013	000	000	000
	10	005	010	017	014	006	000	000	000
	30	004	008	013	012	005	000	000	000
2	50	003	005	009	008	004	000	000	000
	70	002	004	006	006	002	000	000	000
	90	002	003	005	004	002	000	000	000
	10	001	003	005	007	003	000	000	000
	30	001	002	004	005	002	000	000	000
3	50	001	001	002	002	001	000	000	000
	70	000	001	001	002	001	000	000	000
	90	000	001	001	001	000	000	000	000
	10	000	001	001	001	002	000	000	000
	30	000	000	001	001	001	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
HORIZONTAL BLINDS, ANGLE = 75

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	003	005	002	000	000	000	000	000
	30	003	005	001	000	000	000	000	000
1	50	002	004	001	000	000	000	000	000
	70	002	003	001	000	000	000	000	000
	90	002	003	001	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
2	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
3	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
4	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
6	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
8	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000
	10	000	000	000	000	000	000	000	000
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
VERTICAL BLINDS, ANGLE = 0

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	325	436	580	701	823	1017	1221	1225
	30	109	196	274	326	379	443	525	526
1	50	063	129	202	242	282	322	377	378
	70	046	095	162	199	233	266	310	311
	90	038	077	136	172	202	233	271	272
	10	151	238	333	402	459	560	668	675
	30	038	086	154	190	213	249	291	294
2	50	020	047	094	123	141	167	194	196
	70	015	033	064	088	103	125	145	147
	90	013	027	051	069	083	102	120	121
	10	082	161	238	292	332	403	451	463
	30	018	046	093	124	142	170	178	183
3	50	009	023	048	068	081	100	109	112
	70	008	017	032	045	054	069	075	076
	90	007	014	026	036	043	055	060	062
	10	048	115	184	228	265	320	359	377
	30	009	027	058	082	099	122	135	142
4	50	005	013	028	040	051	065	072	076
	70	004	010	019	027	033	043	048	051
	90	004	009	017	022	028	035	040	042
	10	020	061	119	152	178	219	243	273
	30	003	011	027	039	050	065	075	084
6	50	002	006	013	018	023	031	035	040
	70	002	005	010	013	016	021	024	027
	90	002	005	009	012	014	019	021	023
	10	010	033	079	106	125	155	180	221
	30	001	005	014	021	027	037	044	054
8	50	001	003	007	010	012	017	021	025
	70	001	003	006	008	010	012	015	018
	90	001	003	006	007	009	011	014	017
	10	005	019	053	075	090	112	130	177
	30	001	003	008	012	016	022	027	037
10	50	000	002	004	006	008	010	013	017
	70	000	002	004	005	006	008	010	013
	90	000	002	004	005	006	008	009	012

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
VERTICAL BLINDS, ANGLE = 15

ROOM DEPTH / WINDOW HEIGHT		WINDOW WIDTH / WINDOW HEIGHT							W / H
D / H	% D	.5	1	2	3	4	6	8	INF
	10	282	409	566	697	828	1034	1255	1259
	30	069	158	248	306	366	437	526	527
1	50	038	091	171	218	263	309	370	371
	70	028	065	129	172	211	250	299	300
	90	025	052	101	144	179	216	258	259
	10	103	205	311	385	446	553	667	674
	30	020	055	125	166	193	233	279	282
2	50	012	030	068	100	121	150	181	182
	70	010	021	046	067	084	108	132	133
	90	009	018	036	051	064	086	106	108
	10	042	125	213	272	315	391	442	453
	30	008	026	066	101	122	154	165	169
3	50	005	014	033	051	065	086	097	100
	70	004	011	023	033	041	057	064	066
	90	004	010	019	027	032	044	050	051
	10	019	078	157	206	246	305	347	364
	30	003	015	039	062	082	107	122	128
4	50	002	008	019	029	038	054	063	066
	70	002	007	014	020	025	035	040	042
	90	002	006	012	017	021	028	032	033
	10	004	031	092	130	158	203	229	258
	30	001	005	016	027	037	054	065	073
6	50	001	003	008	012	016	024	029	032
	70	001	003	007	010	012	017	019	022
	90	001	003	007	009	011	015	016	019
	10	001	013	053	084	106	139	166	205
	30	000	002	008	013	018	029	037	045
8	50	000	001	004	007	009	013	016	020
	70	000	001	004	006	007	010	012	015
	90	000	001	004	006	007	009	011	014
	10	000	005	028	055	073	098	118	161
	30	000	001	004	007	010	016	021	029
10	50	000	001	002	004	005	008	010	013
	70	000	001	002	004	005	006	008	011
	90	000	001	002	004	005	006	007	010

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
VERTICAL BLINDS, ANGLE = 30

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	223	369	536	672	810	1026	1259	1263
	30	036	108	208	271	334	411	506	507
1	50	023	055	127	178	227	278	343	344
	70	019	041	085	131	173	216	269	269
	90	017	035	064	101	140	181	226	227
	10	050	161	278	356	420	531	649	656
	30	011	030	086	132	161	205	253	255
2	50	007	018	043	069	091	123	155	156
	70	006	014	030	045	058	083	108	109
	90	005	012	025	034	043	062	083	084
	10	013	079	178	242	288	367	422	432
	30	003	014	039	071	094	128	142	146
3	50	002	008	020	033	044	066	078	080
	70	002	007	015	023	028	040	048	049
	90	002	006	013	019	023	030	035	036
	10	003	038	122	176	218	280	325	341
	30	001	008	022	039	058	085	102	107
4	50	001	004	012	018	025	038	048	050
	70	001	004	009	014	018	024	029	030
	90	001	004	008	012	016	020	022	024
	10	000	009	058	100	131	179	208	234
	30	000	002	009	016	023	039	050	056
6	50	000	001	005	008	011	016	020	023
	70	000	001	004	007	009	012	014	016
	90	000	001	004	006	008	011	012	014
	10	000	002	026	057	081	117	146	180
	30	000	000	004	007	011	018	026	032
8	50	000	000	003	004	006	009	011	014
	70	000	000	002	004	005	007	009	011
	90	000	000	002	004	005	007	009	011
	10	000	001	009	031	051	079	100	136
	30	000	000	001	004	006	010	014	019
10	50	000	000	001	002	003	005	007	009
	70	000	000	001	002	003	005	006	008
	90	000	000	001	002	003	005	006	008

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
VERTICAL BLINDS, ANGLE = 45

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	139	310	488	626	764	984	1220	1224
	30	019	052	153	220	283	364	459	461
1	50	013	030	071	124	172	228	293	294
	70	011	025	045	076	118	164	217	217
	90	010	022	036	054	085	128	174	174
	10	011	100	231	313	379	494	612	618
	30	004	015	043	085	117	164	212	214
2	50	003	010	024	037	053	085	117	118
	70	002	008	019	026	033	051	074	075
	90	002	007	016	022	025	035	053	053
	10	001	029	131	199	248	330	389	399
	30	001	007	019	036	056	093	110	112
3	50	000	004	012	019	024	039	052	053
	70	000	003	009	014	017	024	028	029
	90	000	003	008	012	015	019	020	020
	10	000	008	074	133	178	244	292	306
	30	000	003	011	019	030	055	073	077
4	50	000	002	006	011	015	022	029	030
	70	000	001	005	009	012	015	017	018
	90	000	001	005	008	010	013	014	015
	10	000	001	021	060	094	145	177	199
	30	000	000	004	008	012	021	031	035
6	50	000	000	002	005	006	010	012	013
	70	000	000	002	004	005	008	009	010
	90	000	000	002	004	005	008	008	009
	10	000	000	005	024	048	087	117	144
	30	000	000	001	004	006	009	014	018
8	50	000	000	001	002	003	005	007	009
	70	000	000	001	002	003	005	006	008
	90	000	000	001	002	003	004	006	007
	10	000	000	001	009	024	052	075	102
	30	000	000	000	002	003	005	007	010
10	50	000	000	000	001	002	003	004	006
	70	000	000	000	001	002	003	004	005
	90	000	000	000	001	002	003	004	005

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
VERTICAL BLINDS, ANGLE = 60

ROOM DEPTH / WINDOW HEIGHT D / H	% D	WINDOW WIDTH / WINDOW HEIGHT W / H .5	1	2	3	4	6	8	INF
	10	032	212	412	553	687	904	1133	1136
	30	007	017	070	144	207	291	382	383
1	50	005	014	023	050	096	153	216	217
	70	004	012	020	027	049	091	141	141
	90	004	011	018	022	033	057	100	100
	10	001	023	156	247	316	435	550	556
	30	000	005	015	029	054	105	153	154
2	50	000	004	011	016	019	036	065	066
	70	000	003	009	013	015	020	033	034
	90	000	003	008	011	013	016	023	023
	10	000	002	056	133	187	273	339	348
	30	000	001	007	013	018	043	064	066
3	50	000	001	005	009	011	015	020	021
	70	000	001	004	007	008	011	012	012
	90	000	001	003	006	007	010	009	009
	10	000	000	016	068	117	188	241	253
	30	000	000	004	007	011	021	034	036
4	50	000	000	002	005	007	010	012	012
	70	000	000	002	004	006	008	008	009
	90	000	000	002	003	005	007	007	008
	10	000	000	001	013	039	094	131	147
	30	000	000	001	002	004	008	011	013
6	50	000	000	000	002	003	005	005	006
	70	000	000	000	001	002	004	005	005
	90	000	000	000	001	002	004	004	005
	10	000	000	000	002	010	043	075	092
	30	000	000	000	001	002	004	006	007
8	50	000	000	000	000	001	002	003	004
	70	000	000	000	000	001	002	003	004
	90	000	000	000	000	001	002	003	004
	10	000	000	000	000	002	016	040	054
	30	000	000	000	000	001	002	003	004
10	50	000	000	000	000	000	001	002	003
	70	000	000	000	000	000	001	002	002
	90	000	000	000	000	000	001	002	002

ILLUMINANCE FROM TOPSIDE OF BLINDS (EXPOSED TO SUN)
VERTICAL BLINDS, ANGLE = 75

ROOM DEPTH / WINDOW HEIGHT		WINDOW WIDTH / WINDOW HEIGHT							W / H
D / H	% D	.5	1	2	3	4	6	8	INF
	10	000	023	244	408	546	769	983	986
	30	000	003	005	017	062	161	249	250
1	50	000	003	005	005	009	032	088	088
	70	000	002	004	005	008	007	027	027
	90	000	002	004	004	008	006	013	013
	10	000	000	017	100	185	318	435	439
	30	000	000	003	004	004	012	045	045
2	50	000	000	002	003	004	004	008	008
	70	000	000	002	003	003	003	006	006
	90	000	000	001	002	003	003	005	005
	10	000	000	001	014	056	158	238	244
	30	000	000	000	002	002	003	004	004
3	50	000	000	000	001	002	003	002	002
	70	000	000	000	001	002	002	002	002
	90	000	000	000	001	001	002	002	002
	10	000	000	000	001	012	074	139	146
	30	000	000	000	001	002	003	003	003
4	50	000	000	000	000	001	002	002	002
	70	000	000	000	000	001	002	002	002
	90	000	000	000	000	001	001	002	002
	10	000	000	000	000	000	009	038	042
	30	000	000	000	000	000	001	001	001
6	50	000	000	000	000	000	001	001	001
	70	000	000	000	000	000	001	001	001
	90	000	000	000	000	000	001	001	001
	10	000	000	000	000	000	000	007	009
	30	000	000	000	000	000	000	001	001
8	50	000	000	000	000	000	000	001	001
	70	000	000	000	000	000	000	001	001
	90	000	000	000	000	000	000	000	001
	10	000	000	000	000	000	000	001	001
	30	000	000	000	000	000	000	000	000
10	50	000	000	000	000	000	000	000	000
	70	000	000	000	000	000	000	000	000
	90	000	000	000	000	000	000	000	000

SOLAR BLINDS MULTIPLIERS

-- UNDERSIDE, SURFACE HIDDEN FROM SUN --

SOLAR PROFILE ANGLE	BLINDS ANGLE = 0 DEG, BLINDS REFLECTANCE 10%	30%	50%	70%	90%	BLINDS ANGLE = 15 DEG, BLINDS REFLECTANCE 10%	30%	50%	70%	90%
0	000	000	000	000	000	001	011	031	064	113
15	001	011	032	067	119	002	021	061	125	222
30	003	024	069	142	254	004	033	095	195	347
45	004	036	103	214	382	004	033	094	193	343
60	003	030	087	180	320	003	025	073	150	264
75	002	017	048	099	175	001	013	038	078	137

SOLAR PROFILE ANGLE	BLINDS ANGLE = 30 DEG, BLINDS REFLECTANCE 10%	30%	50%	70%	90%	BLINDS ANGLE = 45 DEG, BLINDS REFLECTANCE 10%	30%	50%	70%	90%
0	002	019	055	112	197	003	023	066	134	232
15	003	028	079	161	283	003	028	078	159	275
30	003	031	088	180	315	003	023	065	133	230
45	003	026	075	154	269	002	019	053	108	187
60	002	019	055	113	197	001	013	037	076	131
75	001	010	027	056	097	001	006	017	035	061

SOLAR PROFILE ANGLE	BLINDS ANGLE = 60 DEG, BLINDS REFLECTANCE 10%	30%	50%	70%	90%	BLINDS ANGLE = 75 DEG, BLINDS REFLECTANCE 10%	30%	50%	70%	90%
0	003	023	064	127	217	001	011	031	062	105
15	002	018	051	103	176	001	009	024	048	082
30	002	015	041	083	142	001	007	019	037	063
45	001	011	032	065	111	001	005	014	028	047
60	001	008	021	043	073	000	003	009	017	029
75	000	003	009	018	031	000	001	003	006	011

SOLAR BLINDS MULTIPLIERS

-- TOPSIDE, SURFACE EXPOSED TO SUN --

SOLAR PROFILE ANGLE	BLINDS ANGLE = 0 DEG					BLINDS ANGLE = 15 DEG				
	BLINDS REFLECTANCE					BLINDS REFLECTANCE				
	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%
0	000	000	000	000	000	026	080	139	204	282
15	027	082	141	209	290	052	158	272	401	555
30	057	175	302	446	620	081	247	426	628	868
45	085	259	447	660	917	085	258	444	651	894
60	073	223	384	565	780	073	222	380	554	754
75	044	133	228	333	456	044	132	225	327	441

SOLAR PROFILE ANGLE	BLINDS ANGLE = 30 DEG					BLINDS ANGLE = 45 DEG				
	BLINDS REFLECTANCE					BLINDS REFLECTANCE				
	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%
0	051	155	266	389	531	072	218	372	537	723
15	073	223	382	559	764	087	264	449	648	871
30	086	262	449	654	890	086	261	442	635	847
45	085	257	438	635	856	085	256	432	618	818
60	073	221	375	541	724	073	220	371	528	695
75	044	132	223	319	424	044	131	221	313	409

SOLAR PROFILE ANGLE	BLINDS ANGLE = 60 DEG					BLINDS ANGLE = 75 DEG				
	BLINDS REFLECTANCE					BLINDS REFLECTANCE				
	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%
0	088	266	450	642	849	089	266	446	628	814
15	087	262	442	629	826	087	261	437	615	796
30	086	260	437	619	810	086	259	433	608	786
45	085	255	428	605	788	085	254	425	596	770
60	073	220	368	519	674	073	219	366	513	662
75	044	131	219	308	399	044	131	218	306	394

SKY BLINDS MULTIPLIERS

-- UNDERSIDE, SURFACE HIDDEN FROM SUN --

BLINDS ANGLE	BLINDS REFLECTANCE 10%	30%	50%	70%	90%
0	002	021	060	125	222
15	003	027	077	158	281
30	003	029	084	171	301
45	003	029	082	166	287
60	003	026	073	145	246
75	002	019	054	107	178

-- TOPSIDE, SURFACE EXPOSED TO SUN --

BLINDS ANGLE	BLINDS REFLECTANCE 10%	30%	50%	70%	90%
0	050	153	264	391	543
15	066	200	344	508	702
30	078	238	407	595	813
45	089	270	460	665	894
60	100	303	512	731	966
75	109	329	552	779	1015

GROUND BLINDS MULTIPLIERS

-- UNDERSIDE, SURFACE HIDDEN FROM SUN --

BLINDS ANGLE	BLINDS REFLECTANCE 10%	30%	50%	70%	90%
0	025	077	132	195	271
15	017	054	093	138	193
30	011	036	065	099	141
45	007	024	046	074	110
60	003	015	032	056	088
75	001	009	022	041	067

-- TOPSIDE, SURFACE EXPOSED TO SUN --

BLINDS ANGLE	BLINDS REFLECTANCE 10%	30%	50%	70%	90%
0	001	010	030	062	111
15	002	012	029	055	093
30	007	025	047	075	113
45	015	046	081	121	167
60	025	076	130	186	247
75	037	112	187	265	345

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NATL BUREAU OF STANDARDS Thermal Anal Gp, Wash, DC
NATNAVMEDCEN Code 43, Energy Conserv (PWO) Bethesda, MD
NAVACT CO (Code A171P), London, UK
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NAVOBSY Code 67, Washington DC
NAVOCEANSYSCEN Commander (Code 411), San Diego, CA
NAVORDFAC CO (Code 66), Sasebo, Japan
NAVORDSTA CO (Code 0931), Louisville, KY; Code 0923, Indianhead, MD
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NAVSUPPBASE CO (Energy Conserv) Kings Bay, GA
NAVSUPPFAC CO (Energy Conserv) Diego Garcia I; Code 02, Thurmont, MD
NAVSUPPO CO (APWO), La Maddalena, Italy
NAVSURFWPNCEN Dahlgren Lab, WW-02 Dahlgren VA
NAVTELCOMMCOM Code 05, Washington DC
NAVUSEAWARENGSTA CO (Code 073E2), Keyport, WA
NAVWPNCEN Commander (Code 2635), China Lake, CA
NAVWPNSTA CO (Code 09221), Concord, CA; CO (Energy Conserv) Yorktown, VA; CO (Energy Conserv), Colts Neck, NJ; Code 0911, Seal Beach CA
NAVWPNSUPPCEN CO (Code 092E), Crane, IN
NCBC CO (Code 80), Port Hueneme, CA; CO (Energy Conserv), Davisville, RI
NOAA Library Rockville, MD
NRL PWO Code 2530.1, Washington, DC
NSC CO (Code 46A) San Diego, CA; CO (Code 70A), Puget Sound, WA
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NUSC CO (Code 5204), Newport, RI
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PACMISRANFAC CO (Code 7031), Kekaha, HI
PMTC Commander (Code 6200-3), Point Mugut,, CA
PWC CO (Code 1003), Oakland, CA; CO (Code 100E), San Diego, CA; CO (Code 100E3), Oakland, CA; CO (Code 153), Guam; CO (Code 30), Pearl Harbor, HI; CO (Code 601), Subic Bay; CO (Code 610), Pensacola, FL; CO (Code 613), San Diego, CA; Code 100A, Great Lakes, IL; Code 116, Seattle, WA; Code 154 (Library), Great Lakes, IL; Code 600A Norfolk, VA; Library, Code 120C, San Diego, CA; Library, Guam; Library, Norfolk, VA; Library, Oakland, CA; Library, Pearl Harbor, HI; Library, Pensacola, FL; Library, Subic Bay, R.P.; Library, Yokosuka JA; NAS Pensacola, FL
SPCC CO (Code 763), Mechanicsburg, PA
SUPSHIP ADMINO, San Francisco, CA; Code 901
USNA Code 170, Annapolis, MD

FRANKLIN INSTITUTE M. Padusis, Philadelphia PA
LAWRENCE BERK LAB Window & Lighting Prog. Berkeley, cA
LOS ALAMOS SCI LAB Solar Energy Gp, Los Alamos, NM
MIT Cambridge MA (Rm 10-500, Tech. Reports, Engr. Lib.)
UNIVERSITY OF WASHINGTON Insti. for Envir. Studies
PG&E Library, San Francisco, CA
SANDIA LABORATORIES Library Div., Livermore CA
UNITED KINGDOM LNO, USA Meradcom, Fort Belvoir, VA

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